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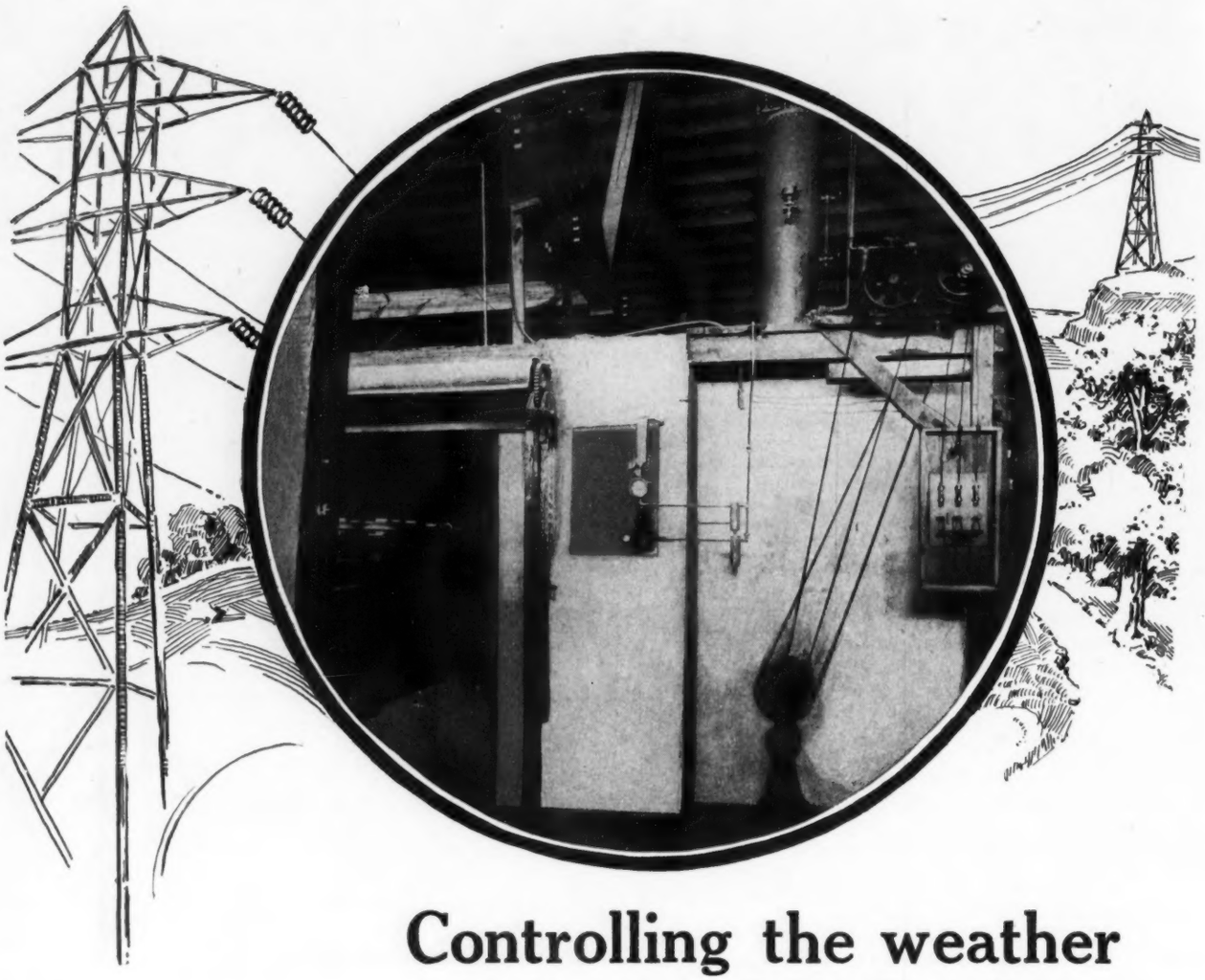

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Engineers Should Travel More

FOREIGN engineers are frequent visitors to these shores. They invariably are in search of information and usually succeed in obtaining what they come for. This leads us to question whether our own engineers travel enough in quest of first-hand knowledge and whether executives properly sense the necessity and value of such journeys. Editors cannot hope to satisfy all engineering needs, invaluable as the technical press is. It is necessary at times to supplement published information by personal inquiry because men are often willing to impart information informally when they would not put their opinions in writing. Knowledge so gained is valuable. No system, for instance, suffering a serious breakdown would, for obvious reasons, desire publicity on details, nor would the manufacturer who supplied the apparatus, and yet they may be most useful in helping engineers to guard against similar mishaps. Notwithstanding the slogan of the telephone companies, travel is good and profitable, and executives should see to it that their engineers do more of it.

Trade Practices and Living Costs

IN ADVISING the President on present trade conditions and their effect on living costs the Federal Trade Commission makes some very definite strictures on certain business practices and abuses. From the fund of data which the commission possesses it is to be assumed that it knows whereof it speaks, but whether its deductions are correct or generally applicable is another matter. Labor has a great deal to do with present conditions, but the commission cannot presume to speak for labor. Nevertheless, the report makes interesting reading and will serve to confirm the general public's belief that prices are still too high. Herein lies a danger to all legitimate and honest business because of iniquitous practices and derelictions in some quarters. That it may lead to regulation is possible but not probable; for while there is nothing to prohibit this, we question whether any industry will permit itself to become so inefficient and corrupt or so abuse its opportunities as to warrant government interference in the public interest. The electrical industry—and it is by no means perfect—does not knowingly commit infractions. Its success is predicated on public good will. Even the suspicion of wrongdoing is repugnant to it, and it can be relied on to remedy most abuses quickly and effectively as a matter of self-interest. We fancy, however, that a portion of the blame for questionable business may be laid at the door of the government itself. In this we do not mean to exculpate those combinations which studiously keep the letter but break the spirit of the law, or to condone their practices. But we believe that it is as much a function of government to advise as it is to threaten. The old adage that an ounce of prevention is worth a pound of cure still applies, and admonition is certainly just as effective in business as chastisement. We are glad to note that the Federal Trade Commission appreciates this and has suggested remedies in that spirit. We commend its report to the serious consideration of the industry.

Fruitful Field for Engineer and Manufacturer

THE most pressing mechanical problem confronting the railroads has to do with terminal facilities, and in its proper solution the electrical industry can be of great service. In fact, few fields as fertile and as remunerative are open to the electrical engineer and manufacturer at the present time. Creative genius of a high order is essential because nothing short of a radical change from present inadequate and cumbersome methods will suffice. It is unfortunate but nevertheless true that the arrangement and construction of the average freight station is archaic. Were one to hunt for the worst possible misfit for existing needs he need look no farther than freight stations in large centers. The arrangements not only militate against efficient hand operation but are to a far greater extent a handicap to the proper application of mechanical and electrical machinery. For that reason existing terminals must be replaced by structures providing for minimum time-consuming movements between cars and the shipper or consignee. Such terminals on a large scale do not exist at the present time and are a consummation devoutly to be wished. The opportunities for economy justify very generous outlays on them since it is estimated that lack of proper freight-handling equipment costs the country approximately half a billion dollars yearly. The industry should therefore actively support any plans for effectively solving terminal and freight-handling problems, first, because they mean cheaper distribution and, second, because they involve the use of electrical equipment and lots of it.

The "Big Nine" Central-Station Companies

BUSINESS as applied to finance and industrial undertakings has quite a different meaning today from that it bore fifty years ago. We have come to think of billions instead of millions as indicative of large things, and this is perfectly logical in view of the rapid growth which has taken place in every line of human endeavor. A decade ago a central-station company which generated and distributed in excess of a hundred

million kilowatt-hours was considered as one of the leaders in the industry. Today outstanding leadership based upon the extent of the annual output is designated by adding three more zeros to the quantity, bringing it into the billion kilowatt-hour range. There are now nine of these "leaders" among central-station companies when measured by this scale, seven in the United States and two in Canada. Sixty-two others are in the hundred-million class, exclusive of nine electric railway companies. The rank by companies is shown elsewhere in this issue. In the tabulation of annual output the extremes to which the larger distributers of electrical energy have been driven during the past few years are clearly brought out. Prior to the war most generating companies purchased power from other public utilities only at irregular intervals when there was an abnormal request for energy beyond the ratings of their own generating stations and to help out in emergency cases. The figures for 1920 indicate, however, that purchase of energy from competitors is now rather the rule than the exception and that a majority of the large electric distributing companies are buying a high percentage of their total output. This interchange of energy has been accentuated by the rapid advances made in the interconnection of large systems, but it is without doubt also due in no small extent to the high cost of labor and materials which has prevailed since the end of the war. However, some of the larger companies have additional generating units now under construction or contemplated, and it is probable that the next year or so will see a material reduction in the amount of electrical energy purchased by these companies for distribution to their customers.

A Record of Which Canada May Be Proud

OUR friends across the northern border have shown in the last year an amount of activity in power-plant planning and construction which speaks volumes for the energy with which they have confronted the new conditions since the war. The report presented in this issue is of the most encouraging possible character. As our readers know, the Canadian government has taken a very active hand in regulating, and indeed operating, hydro-electric propositions. The several provinces have so considerable a degree of autonomy that they operate somewhat independently, but effective efforts have been made toward community of action which should prove decidedly useful in future work. In four of the provinces the work of development and transmission is actually being undertaken by the government, these four being Nova Scotia, New Brunswick, Ontario and Manitoba. Neither of the two first-named provinces is very rich in easily available powers, but there is an ample supply for present requirements and for some little time to come. In both these provinces government activities will prove specially effective on account of the ease with which they can bring about proper co-ordination with the lumbering interests, for the benefit of which the streams have heretofore been chiefly employed.

The Province of Quebec has already done much in the improvement of its streams and more than 100,000 hp. of new development work has been moving along in this last year. Ontario, of course, with its Hydro-Electric Power Commission, is the chief seat of activity, with nearly 500,000 hp. under construction. The commission now owns more than 1,000,000 hp. in total capacity. In the western provinces of Canada there is plenty of water power awaiting development of adequate markets. Not a little work is being carried on in the general distribution of light and power by construction and transmission networks, but until one reaches the Pacific and considerable centers of population developments are necessarily limited. Their total at the present time, however, is something rather astonishing, rising to very nearly 2,500,000 hp. for a total population of about 9,000,000, a per capita supply of power surpassing that of every country in the world save Norway.

Serious Effects of Fiber Shreds in Transformer Oil

THE deleterious effect of water on transformer oil has long been known. Recently attention has been drawn also to the importance of the more complete elimination of other impurities. Of interest in this connection is a series of experiments by Thomas McLaughlin, described in a recent number of the *Electrician*, on the influence of dust and small fibers on the insulating properties of transformer oils. Paraffine and other oils supposedly pure are shown to develop sudden sharp increases in conductivity. These changes occur at widely different values of electric stress in the same oil, and the duration of time of application is an important factor. Careful experiments clearly trace the cause to the presence of minute fibers in the oil. By microscopic examination the fibers can be seen, and the sudden increase of conductivity always results when a number of the fibers link up end on end in the electric field.

Since insulation is only an extreme reduction of conductivity, the effects of impurities are much greater in insulators than in conductors. For this reason the insulating properties of any single substance show wide variation under successive tests. This is especially noticeable in compound and built-up insulation. Particularly in liquid insulation is the effect of impurities noticeable. Water with its powerful dissociating properties, loosening the bonds of the atoms, if present even in minute quantities, sharply increases the conductivity.

Much of the insulation used in transformers is fibrous in character. Waste and lint-bearing cloths are also commonly used for cleaning purposes. The experiments mentioned thus raise the questions whether complete precaution is taken against the passage of fibers into the oil, whether oils should not be examined more rigidly for impurities of this character and whether conductivity tests such as those described have not some advantages over the usual breakdown tests.

The Tangle of Existing Frequencies in Power Service

IT IS unfortunate that some duly qualified prophet could not have been on hand in the early days of power transmission to look ahead and see the general situation with regard to standard frequency. As a matter of fact, we are better off in this country than they are abroad, at least in regard to the number of frequencies in actual use. We are worse off in that there are two widely different and in a sense incommensurable frequencies both in large use. By far the greater part of new plants are for 60 cycles, but there remain, chiefly as relics of an earlier phase of experience, 25-cycle plants to an aggregate capacity so big that a general change is for the present out of the

question. In the current issue B. G. Lamme considers this frequency difficulty with reference to the installations in steel mills, which have been in the past very generally equipped for 25 cycles but now frequently make clear the desirability of taking on power from the great transmission systems at the higher frequency.

The fact is, of course, that 25 cycles is obsolescent, but this frequency has been employed on so large a scale that a long period must elapse before it passes out of use. Started in the first great Niagara plant as a compromise, the story of which would make an interesting bit of history, it has persisted there and has been also largely used in plants, chiefly for railway purposes, installed when engineers were still somewhat skeptical about building synchronous converters for the ordinary frequencies. It also found use in isolated plants for steel mills where the low frequency was often convenient for low-speed motors and also for conversion into direct current. Today there is no hesitancy about building conversion apparatus for 60 cycles, and even if it were difficult to do this, there would still remain the extremely effective cascade converter with a commutating frequency cut in half.

The great mistake which found its way into American practice was standardizing two frequencies which, as Mr. Lamme points out, were pretty nearly incommensurable. It would have been far sounder practice had engineers possessed the foresight to use either 50 cycles for high frequency and 25 for low, or 60 and 30 cycles.

Looking at the situation as it stands, when it is desirable to take 60-cycle power in one of the low-frequency plants Mr. Lamme points out five ways of meeting the situation—first, by discarding existing plant; second, by using frequency changers up to the full capacity of the existing plant, which is expensive; third, by installing additional plant for the standard frequency and holding on temporarily to the 25-cycle plant—feasible enough in some cases, but a mixed system at best; fourth, by changing over part of the plant, leaving the rest as it is until it finally becomes obsolete—again a mixed system probably for a considerable time; and, finally, the existing plant can be utilized within limits and all extensions made on the standard frequency. Here again is a double system, but not a mixture of two in the same area. Mr. Lamme's judgment, in which we think all engineers will concur, is that it is not desirable to generate two frequencies in the same local plant unless one is to be discarded within a very short time. Additions of small size can perhaps best be made on the existing frequency.

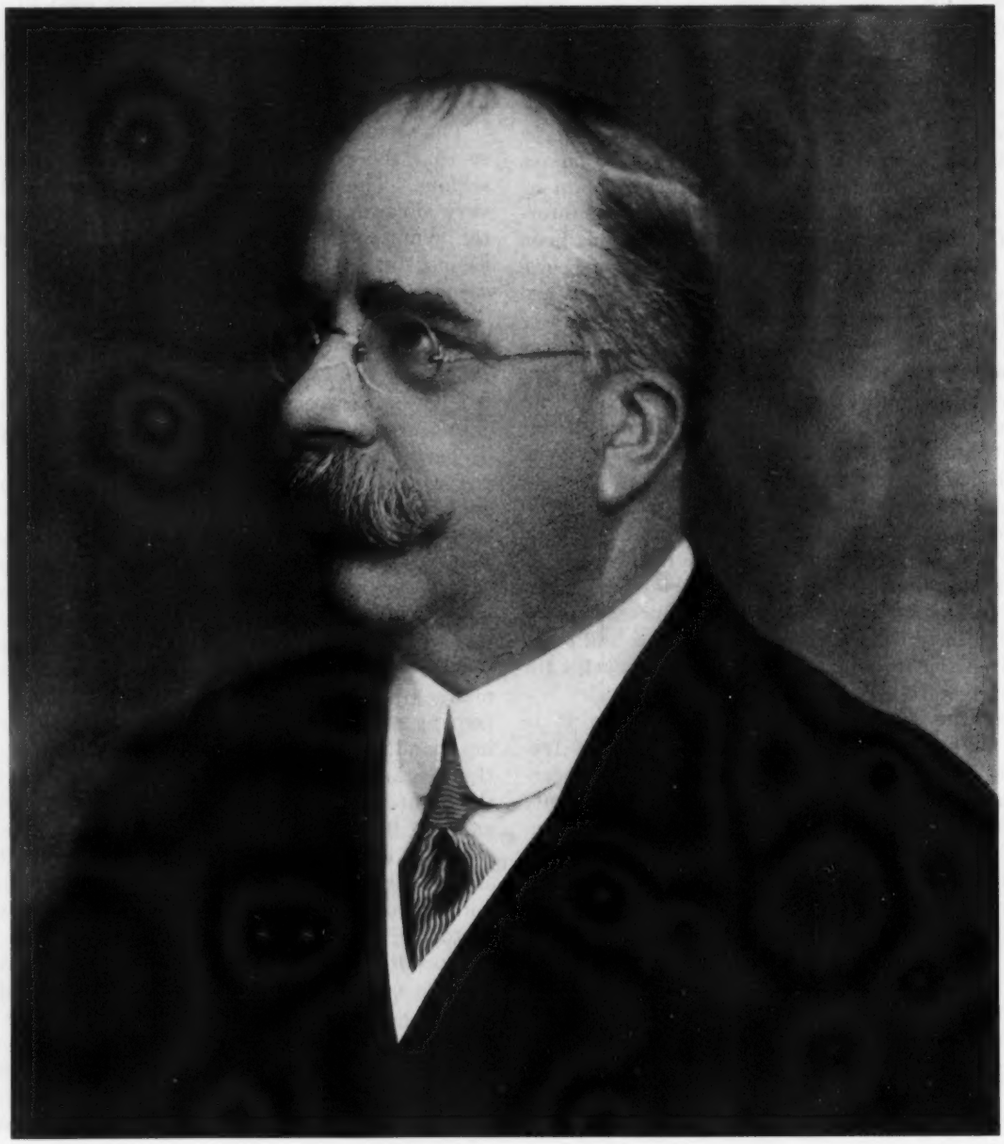
The big central-station companies of the country have been subject to a certain extent to the same mixed conditions. Rather unwisely, as engineers now generally judge, they went in largely for 25 cycles with the intention of using synchronous converters instead of distributing on alternating current. At 25 cycles with modern lamps the lighting service gets on the ragged edge of practicability, and as time goes on the direct-current service is a less and less important part of the whole. So much investment has been put in 25-cycle apparatus, however, that it is better to stand the inconvenience than to scrap the equipment, which is exactly the case in the steel mills. A frequency-changer outfit is cheaper in first cost than additional generating plant and sometimes may afford an excellent way out of the difficulty. Where cheap transmitted power is available it will commonly be better judgment to utilize it through a frequency changer than to undertake any wholesale changes in the motor plant to meet the new situation. At all events, if both frequencies are actually to be used in the service, they should be kept distinct as far as possible, in which case it has often been feasible to avoid the use of frequency changers and to keep the two frequencies independent, letting the question of future growth take care of itself.

The whole situation is an inconvenient one, the more so that the cost of a complete change in frequency is serious. The only thing to do is, following Mr. Lamme's very shrewd analysis of the situation, to treat the matter symptomatically, getting out of the tangle by the easiest feasible method, which may lead in any one of several directions.

The Job of the Line Foreman

IT IS being recognized more and more that planning engineering work is a function entirely separate from executing the practical details of that work. Both have the same ultimate object, but the points of view are sometimes diametrically opposite. The fact that the best results from all standpoints are obtained where these endeavors are handled separately invariably leads to this conclusion. To no other problem in the industrial world has more thought been given than to the separation of engineering and construction work, and none has seemed harder to solve. However, results obtained in many enterprises have conclusively proved that engineering and construction must be carried on separately but handled co-operatively. Nowhere in a central-station organization has it been more difficult to convince those interested that such a division of work is an advantage than in the distribution departments. The line foreman of old planned his work and did it. He had entire control of the situation, and the lines that he built remained standing and gave good service to the customer. But each foreman had his own ideas, and the result was a complete absence of standardization. The economics of the problem were not considered. The fact that the line foreman in most cases was successful in giving the customer the service required has made it difficult to convince not only him but often the management also that better results and higher economies could be obtained by the application of engineering principles.

One result has been constant iteration of the fallacy that were the foreman furnished with definite orders or blueprints he would become merely a machine. It is necessary simply to look over conditions in other more highly organized forms of work to find that the doing of the work in itself carries with it a possibility of unlimited mental application. It is hardly yet possible to appreciate what can be done by proper routing, by properly planning the work of line gangs, by saving time in all operations, by labor-saving methods and devices, by competition between gangs—in short, by doing a piece of line work in the least possible time with the least possible expenditure of labor while still maintaining the quality of work required for the service to be given. It is therefore necessary, in order that distribution work may keep up in efficiency with work of other kinds, to realize that the line foreman is losing nothing of his importance by giving up some of his apparent engineering duties. He is simply relieved of work for which he is not fitted and thereby permitted to spend his best efforts in doing the work that he should be best able to do.



Frederic Nicholls

The pioneer organizer of the electrical industry of Canada, who has resigned the presidency of the Canadian General Electric Company to become chairman of its board of directors

TO THE vision of Frederic Nicholls the electrical industry of Canada owes much. He was among the first to see the future of electric lighting and so started the first Canadian incandescent lighting system. The demand for electrical equipment which followed he supplied by obtaining the Canadian rights to manufacture a comprehensive line of electrical apparatus. To use the power generated he promoted street railways, and then when the demand increased he began to urge the development of Niagara Falls. To utilize this energy he became interested in the pioneer high-tension lines in Canada.

Briefly, these are the outstanding early accomplishments that have so closely linked the name of Lieut-Col. Frederic Nicholls with Canadian electrical progress for so many years. As president of the Canadian General Electric Company, essentially a Canadian organization operating entirely under its own control, he has taken a prominent part in all electrical development in the Dominion. This company, under his personal control and direction since 1889, when the initial undertaking was formed, has grown from an original investment of $10,000 to current assets of $31,000,000. With this record of achievement, he recently resigned as president to become chairman of the board of directors.

Colonel Nicholls was born in England in 1856 and was educated in Stuttgart, Germany. It was in 1874 that he came to Canada. For seven years he was secretary of the Canadian Manufacturers' Association, and until 1893 he was editor and proprietor of the *Canadian Manufacturer*, which he founded. The first system for supplying electric light to the Canadian home was the Toronto Incandescent Light Company, which came into being June 26, 1889, as the result of Colonel Nicholls' efforts. Later the company obtained the exclusive Canadian rights to the Edison lighting system, and it was amalgamated with the Toronto Electric Light Company in 1891, giving way to the Toronto Construction & Electrical Supply Company, which acted as Canadian agent for the Thomson-Houston Company. It was thus the immediate parent of the Canadian General Electric Company, which was organized on Sept. 5, 1892. Nor has Colonel Nicholls confined his activities altogether to Canada. With other prominent Canadians he was interested in the Sao Paulo (Brazil) electrical consolidation and later, for a while, in the Rio de Janeiro system.

Colonel Nicholls enjoys the honor of having been the only president of the National Electric Light Association living outiside of the United States, his election to that office taking place in 1896. Since then he has been elected an honorary member of the association. He was gazetted honorary lieutenant-colonel shortly after the outbreak of the war in 1914 and took a prominent part in Canadian war activities. In Jan. 20, 1917, he was appointed to the Canadian Senate.

The Steel-Mill Frequency Problem

How to Make Economical Use of 60-Cycle Purchased Energy in a Plant with 25-Cycle Equipment Is One of the Problems that Confront the Steel Industry—Six General Methods in Arriving at a Solution

By B. G. LAMME
Chief Engineer Westinghouse Electric & Manufacturing Company

WITH the coming of large central power stations for the general supply of electric service of all kinds the frequency of 60 cycles has been brought into more general use. Consequently, in considering the purchase of power from the large supply companies, the steel mills are now confronted with the problem of utilizing 60 cycles to best advantage in plants which were originally designed for 25-cycle equipment. Various suggestions have been made from time to time as to how to handle this situation in its various forms. Probably as good a way as any to attack the problem would be to classify the various methods by which the double-frequency situation could be met. These methods may be stated as follows, although the order in which they are given has no relation to their expediency or importance:

1. Rebuilding or rendering obsolete existing plant and replacing it entirely with 60 cycles.

2. Conversion of 60-cycle purchased power to 25 cycles by frequency changers and operating in connection with existing plant. This retains the advantage of the existing 25-cycle system, but means, however, considerable losses due to the freqency changers.

3. Allowing the existing 25-cycle plant to remain in service and installing new generating and motor equipment for 60 cycles. This would allow purchased 60-cycle power to be utilized in connection with the new generating plant. It involves, however, a more or less mixed system throughout the plant.

Retaining the Existing Plant

4. Retaining the existing 25-cycle plant for those parts of the service where 25 cycles is materially better and changing other parts to 60 cycles for use on purchased power. This could be continued until the old plant and equipment became obsolete. It would probably mean a mixed system throughout the mills for years to come.

5. Utilizing the existing plant within certain areas and applying 60-cycle purchased power to extensions and new areas. This involves a double system, but not a general mixture of two systems in the same areas. Eventually, if the purchased power proved more satisfactory than the local supply, the latter could gradually be discarded. This method means, however, that in the new areas the 60-cycle energy would be applied to low-speed motors as well as all other apparatus.

Looking at the matter broadly, it does not seem advisable to generate two separate frequencies in the local plant. If 25 cycles is the existing frequency, it is not desirable to put in an additional generating plant at 60 cycles, unless such new equipment is to be of greater capacity than that already installed. In the latter case it might be advisable to put in the additional plant of 60 cycles, simply with the understanding that the older small 25-cycle plant would soon be superseded entirely. In other words, the only condition under which the two frequencies should be mixed in the one generating plant is where one of them is to be abandoned entirely within a reasonably short time. Wherever the additional plant is to be less in size than the plant already installed, or where it simply represents the normal growth, then it appears that it would be better to put in the additional plant at the same frequency rather than mix the two frequencies.

Service Should Not Be Mixed

Some of the large central stations throughout the country have encountered a similar problem. In some of these cases both 25-cycle and 60-cycle generating units have been installed in the same power plant, but as a rule they supply quite different service and areas. For instance, the 25-cycle service will be utilized almost entirely by conversion to direct current, and within a given district this will apply exclusively. In other cities the 60 cycles may be represented by entirely separate power plants supplying outlying districts mostly, a large part of the application being by direct service instead of by conversion to direct current. As far as the writer knows, in general the two services are not mixed indiscriminately. In the earlier days, when 60-cycle service came into considerable demand in connection with 25-cycle plants, frequency changers for giving 60 cycles were installed in many cases. As the 60-cycle service grew, instead of adding more frequency changers, whose sole function is to change frequency, not to generate power, the practice has been to install 60-cycle generating units often in separate power plants, the existing frequency changers then being used as a tie between the two plants. In cases where the capacity of the two power plants has been considerable compared with the capacity of the frequency changers tying them together there have been certain conditions of unusual stresses in the frequency changers at times of severe load conditions. In other words, if the link tying the two plants together is a relatively weak one, sometimes it may be broken. This problem of the two frequencies has been one of long standing with the central power stations, and as the present solutions are more or less a development from experience, this is possibly an indication that steel mills should follow along somewhat similar lines.

Using Two Frequencies in One Plant

It has been suggested that in the application of 60 cycles to steel mills this frequency might be used largely for one kind of service, such as the motor-generators or rotaries for producing direct current. In this way the 60-cycle service need not be distributed so generally throughout the mills, but would simply be

NOTE.—The above paper was presented at a joint meeting of A. I. E. E. and A. I. and S. E. E. at Pittsburgh, April 16, 1921.

supplied to the converting machinery, which is not scattered through the mills in the same way as the motors. Moreover, the modern 60-cycle synchronous motor-generator is just as cheap and economical as its 25-cycle competitor—cheaper in some cases—while the 60-cycle rotary converter, if transformers are included, approaches pretty close to the 25-cycle in general operating characteristics.

In existing mills, however, changing to 60 cycles would mean replacing or remodeling, at very considerable expense, the existing motor-generators and rotaries, and unless the future growth of such apparatus is to be very large compared with that already installed, this reconstruction or replacement might prove in the end to be relatively expensive—perhaps as expensive as the installation of frequency changers, which would allow the continuation of the existing 25-cycle frequency. Even if the existing machinery is more or less out of date, unless it has uneconomical characteristics, it can probably be kept in service for many years to come, for much of this machinery is well built and of durable construction and may still have twenty to thirty years of good operative life. In fact, some of the motor-generators and rotary converters which have been in operation for ten to twenty years in steel mills appear to be as good as when first installed, and it will be difficult to justify their obsolescence and replacement.

Something might be said further regarding frequency changers. As stated before, the function of the frequency changer is simply to change frequency at a considerable expense in power. There are other objections outside of inefficiency which count against the frequency changer, but these probably would not be dominating or controlling in themselves. On the face of it the frequency changer seems to furnish such a simple solution of the frequency problem that in some instances it might pay to sacrifice other considerations in favor of simplicity.

PROPER POLE COMBINATIONS FOR 25-CYCLE FREQUENCY CHANGERS

It must be kept in mind, in the first place, that there are no means for getting the exact 60 to 25 relation with an economical type of machine, for the numerical ratio of 60 to 25 allows only a 24-10 pole combination, which represents a rather low speed except for units of enormous capacity. If any other more economical combination of poles is chosen, such as 10-4 or 14-6, then with a 60-cycle supply system some other frequency than 25 cycles will be obtained. The 10-4 pole combination gives 24 cycles, while the 14-6 pole combination gives 25.7 cycles. Therefore, for either of these combinations, it would be necessary to change the steel-mill frequency slightly, for it would be almost impossible to get any general power company to change its frequency of 60 cycles. Naturally, if either of the above combinations were to be adopted, the 10-4 pole would be preferable from the standpoint of the frequency changer itself. However, there might be some question regarding the use of 24 cycles instead of 25 cycles in steel-mill applications, for this means a general reduction of 4 per cent in the speed of all the synchronous and induction motors. Thus the choice of the most advantageous speed for the frequency changer may possibly represent a material disadvantage in the motor equipment. Again, the use of the 14-6-pole frequency changer would mean increasing the mill frequency about 3 per cent, which should not be as objectionable as a reduction of 4 per cent. However, the 14-6-pole combination would not represent nearly as cheap frequency transformation.

As an offset to the cost of the frequency changer and its losses, there may be considerable saving over the installation of corresponding capacity in additional power-generating plant. In installing new or additional power plant the cost of the electric machinery represents but a small part of the total cost, and, unquestionably, the extra buildings and equipment to go with the frequency changer would be very materially less than that of additional generating plant. This saving in first cost in some cases might go a long way toward offsetting the losses of the frequency changer, especially in those cases where 50-cycle power can be obtained at a very low rate. However, no definite statement can be made as to the comparative costs, because each case would have to be worked out individually.

POLE RATIOS MUST BE SAME FOR PARALLEL OPERATION

As soon as two or more frequency changers are to be installed in one plant, these to be operated in parallel with each other and with the existing generating plants, then complication comes in, possibly to such an extent as to cause most of the simplicity of the scheme to be lost. The synchronizing and proper paralleling of two or more frequency changers with each other and with their respective power plants is one of the "fussy" things which can be carried out successfully, but which nobody likes.

Attention should be called to the fact that if any particular combination of frequency changer sets is chosen, such as represented by 10-4 poles or by 14-6 poles, then this exact ratio must be retained throughout, if additional frequency changers are ever to be added to the plant. It is obviously impossible to parallel two combinations of poles which do not have the same ratio.

As to the capacities of such apparatus which are practicable in single units, 10-4-pole sets of 5,000-kva. rating have been offered recently by manufacturers. However, for larger ratings than 5,000 kva. certain difficulties arise, as the next possible pole combination is 20-8, which represents just half of the speed. In consequence, even with a 10,000-kva set, halving the speed will probably more than offset the gains in cost and efficiency resulting from larger capacities. One would assume, in consequence, that two 5,000-kva. units would be preferred to one 10,000-kva. unit, and presumably this is correct if the two units can be operated independently. For parallel operation, however, the added complexity might be considered sufficient to offset a slight increase in cost of the larger unit.

COST OF FREQUENCY-CHANGER SETS VARIES

For costs and efficiencies of such apparatus the following approximate figures are suggested:

For a 5,000-kva. set, including auxiliaries, switchboard appliances, etc., from $10 to $11 per kva. The combined efficiency will be approximately 92 per cent or better at full load and 89 per cent or better at half load.

For a 10,000-kva. set, having 20-8 poles, the cost per kva. could be taken roughly at $11 to $12. No figures for efficiency have yet been worked out.

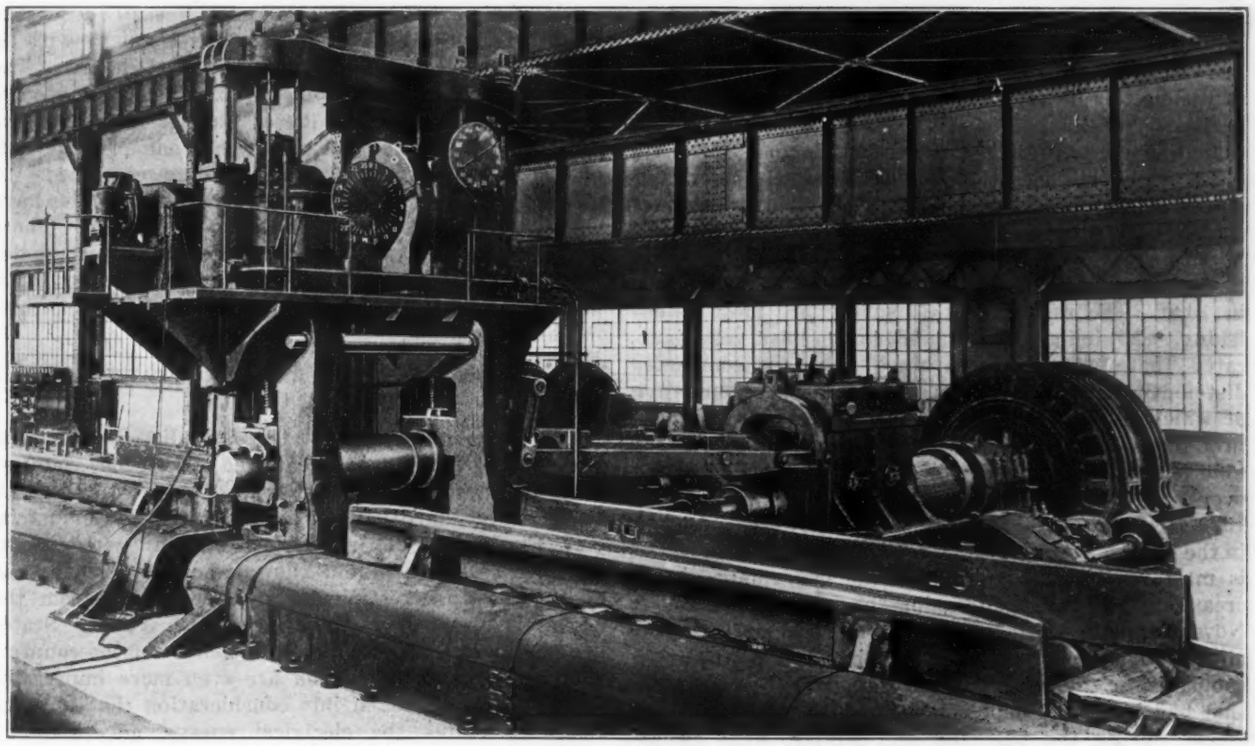
Neither of the above approximations includes cost or efficiency of stepdown transformers.

There is one other class of electric machinery used in steel mills on which the effect of frequency has not yet been considered, namely, the induction-motor speed-

regulating sets which have come into use to a considerable extent in recent years. There are three types of such speed-regulating appliances in use today, all of them requiring commutating machinery, namely, (a) those in which the secondary electrical power of the induction motor is transformed into the mechanical power and utilized as such, (b) where the secondary electrical power is transformed into direct current and utilized, and (c) where the secondary power is transformed from the variable or adjustable frequency of the secondary to some fixed frequency such as that of the line and thus utilized. The first of these schemes involves polyphase commutating-type motors, while the second requires rotary converters and the third requires commutator-type frequency changers, which are a more recent development than the other types of machinery mentioned.

From the standpoint of commutation, (a) and (c) present advantages in first cost, general performance and efficiency at 25 cycles, as compared with 60 cycles, while method (b), involving rotary converters, makes its best showing at 60 cycles, although all three arrangements are practicable at both frequencies. Arrangements (a) and (c) allow satisfactory operation both above and below the synchronous speed of the induction motor, whereas (b) has heretofore been worked only below synchronism, although auxiliary means may be found for this scheme, just as with the other two, for successfully passing the synchronous speed condition. All these methods of speed control could doubtless be used to a considerable extent, depending upon the conditions and the application; but as they can be operated successfully on both 25 cycles and 60 cycles, apparently they will have no controlling influence on the choice of frequency.

There is no good general solution to this frequency problem, and each case must be handled on its merits, taking the future tendencies and growths into account. In many cases it appears that the large existing 25-cycle local systems should be retained at least until such time as the need for replacement is more obvious than at present. Unless the future service of the mill shows strong indications of going almost entirely to 60 cycles, a mixed generating plant is not to be recommended. In those cases where existing 25-cycle power and purchased 60-cycle power are both to be used, they should at first have their own individual services or areas, as far as possible, to avoid indiscriminate mixing of services throughout the mills and to avoid frequency changers, with their attendant losses, unless conditions are such as to warrant their use. In general, where both frequencies are liable to be used for some time to come and there is any real necessity for a tie between the two, frequency changing becomes a necessity. However, as central-station service has now become quite reliable, there is not the need for a tie between two frequencies that was formerly the case, so that doubtless in many cases frequency changers can be dispensed with.



CHANGING CONDITIONS HAVE TAKEN AWAY MOST OF THE ADVANTAGES OF 25-CYCLE ENERGY

In case of a new plant, even where it expects to generate its own power, in general it should be installed at 60 cycles, if located in a 60-cycles district, simply on account of future possibilities. There is no question whatever that future central stations will supply power for general purposes at 60 cycles within certain large districts, the trend being too strong to be changed or controlled. In other large districts it will be principally at 25 cycles, as in the territory served by Niagara, for instance. There will be still other cases where both frequencies will be used, simply because the field for 25 cycles is already so large that 60 cycles cannot replace it. In consequence of this mixed service the ultimate solution of the general supply problem may mean 60 cycles for general purposes with 25 cycles as an auxiliary supply.

Output of Nine Electric Systems in 1920 Exceeded 1,000,000,000 Kw.-Hr. Each

"Electrical World" Survey Indicates that in 1920 Seventy-one Light and Power Companies of United States and Canada Reported Individual Output Exceeding 100,000,000 Kw.-Hr.

GROWTH in the electric light and power industry reaches such large yearly proportions that an annual census of operations is necessary in order to keep the statistics of the industry in such form as to be of real use. Facts which hold true one year are entirely superseded during the year succeeding, and other more astounding data take their place. Probably no other American industry can show as great advances from year to year, and certainly no other industry can surpass the growth of the electric light and power industry during the past decade.

In line with its policy of keeping in most intimate touch with the operations of the central generating plants of the country, the ELECTRICAL WORLD has just completed a survey of the electric generating and distributing companies of the United States and Canada having an annual output in excess of 100,000,000 kw.-hr. in 1920. The results of this survey are most astonishing. A similar survey undertaken last year indicated that in 1919 there were only six companies distributing in excess of a billion kilowatt-hours, five of which were operating in the United States and one in Canada. The present investigation indicates that nine electric light and power companies distributed over a billion kilowatt-hours of electrical energy in 1920. Of these nine companies, seven were operating in the United States and two in Canada. Such a growth is most remarkable in view of the very material decrease in the power load during the months of October, November and December which was reported by virtually all the large electric generating and distributing companies of this country and Canada. It is probable that had industrial depression not settled over the continent during the past fall and winter, some twelve companies would have reported an output of more than a billion kilowatt-hours in 1920.

EIGHTY COMPANIES WITH AN OUTPUT OVER 1,000,000,000 KW.-HR. IN 1920

Table II is believed to be a complete list of the electric light and power companies and electric railway companies of the United States and Canada with an output in excess of 100,000,000 kw.-hr. during 1920, giving also their total output and the amount and date of their peak load. Table I lists these companies by sections of the country and gives the proportion of the output which was generated and purchased and also the distribution of the energy between light and power customers and electric railways.

Seventy-one electric light and power companies and nine electric railway companies reported an output in excess of 100,000,000 kw.-hr. in 1920. The total output of these electric light and power companies was 33,190,281,511 kw.-hr. Deducting the output of the Canadian companies gives 27,109,529,800 kw.-hr. as the total output of the electric light and power companies in the United States having an annual output in excess of 100,000,000 kw.-hr. This would indicate that about 59 per cent of the total output of the central generating stations of this country is distributed by sixty-six companies out of the total 5,700 electric companies operating during 1920.

The Niagara Falls Power Company easily leads the country in output. It is also the only company with an output in excess of two billion kilowatt-hours. The Commonwealth Edison Company of Chicago is second, followed by the Pacific Gas & Electric Company and the Sierra & San Francisco Power Company, the output of the last two companies being combined. A glance at Table II shows that these three companies have also led the industry for the past four years. There are several companies whose output was just under 100,000,000 kw.-hr., and these companies, under usual business conditions, must undoubtedly have appeared in this tabulation.

LARGER COMPANIES ARE WELL SCATTERED OVER THE COUNTRY

The larger electric generating and distributing companies are fairly well scattered over the country, although most concentrated in the industrial sections. It is rather surprising that the intensely industrial New England section reports no company with an output in excess of a billion kilowatt-hours. Perhaps one of the most interesting facts to be drawn from the survey is the large part that the South Atlantic States are playing in the electrical development of the country. The figures for this section are even more impressive when the fact is taken into consideration that in some Southern states the electrical energy generated by private plants is in certain industries in excess of that purchased by these industries from the central generating stations.

The wide use of electrical energy in the Pacific Coast States is emphasized in the two companies reporting over a billion kilowatt-hours' output and the ten other companies with an output in excess of 100,000,000 kw.-hr. No other section of the country can show a better record.

A study of the reported outputs reaching more than 100,000,000 kw.-hr. in 1920 shows that privately owned plants compose almost the entire list. Only two municipal generating plants are found, both of which are in the Pacific States. The almost total absence of municipal plants is not so remarkable when the fact is considered that electric light and power plants of this class are mostly small and serve as a rule but one community, while one privately owned plant may cover a territory embracing many separate municipalities. Moreover, large cities which support municipal light and power plants are generally served by private com-

Table I–Data on Generated and Purchased Output of Largest Generating and Distributing Systems in the United States and Canada During 1920

Section and System	Rank in C'ntry	Generated and Purchased Output			Per Cent of Total Output of Sect'n	Distribution of Energy	
		Kw.-Hrs. Generated	Kw.-Hrs. Purchased	Total Output		Light and Power	Railways
New England States:							
New England Power Company	26	217,868,000	213,050,000	430,918,000	15.4	381,218,000	49,700,000
Edison Electric Illuminating Company of Boston	32	377,276,200	17,800,000	395,076,738	14.1	395,076,738	12,305,864
Narragansett Electric Lighting Company	46	207,900,000	5,332,000	213,232,000	7.6		
Turners Falls Power & Electric Company	47	197,097,030	15,829,500	212,926,530	7.6	180,497,030	32,429,500
New Bedford Gas & Edison Light Company	69	107,599,392	None	107,599,392	3.8	95,468,792	12,130,600
Hartford Electric Light Company	71	94,000,000	9,000,000	103,000,000	3.7	94,000,000	None
Middle Atlantic States:							
Niagara Falls Power Company	1	2,328,326,064	None	2,328,326,064	19.2	2,318,848,901	9,477,163
New York Edison Company	4	842,260,806	95,842,452	938,103,258	7.7	816,683,334	121,419,924
Public Service Electric Company	10	892,339,164	20,560,808	912,899,972	7.5	653,186,298	259,713,674
Philadelphia Electric Company	11	910,065,068	262,625	910,327,693	7.5		
Duquesne Light Company	13	807,314,770	3,086,636	810,401,406	6.7	604,340,557	206,060,849
Buffalo General Electric Company	18	117,081,600	427,211,810	544,293,410	4.5	468,716,410	75,577,000
Niagara, Lockport & Ontario Power Company	21	144,769,880	347,696,580	492,466,460	4.0		
United Electric Light & Power Company	4	406,622,147	38,344,681	444,966,828	3.7	389,964,147	55,002,681
Pennsylvania Power & Light Company	29	411,639,501	None	411,639,501	3.4		
Brooklyn Edison Company	33	382,963,027	None	382,963,027	3.1	380,952,107	2,010,920
Adirondack Power & Light Corporation	39	205,500,000	71,600,000	277,100,000	2.3	258,500,000	18,600,000
Pennsylvania-Ohio Power & Light Company	41	255,537,150	None	255,537,150	2.1	212,448,736	43,088,414
Rochester Gas & Electric Corporation	50	185,010,252	8,591,338	193,601,590	1.6	138,754,995	54,846,595
Metropolitan Edison Company	61	133,657,230	336,800	133,994,030	1.1	117,347,137	16,646,893
Scranton Electric Company	65	105,813,032	10,574,440	116,387,472	1.0	94,680,312	21,707,160
South Atlantic States:							
Southern Power Company	14	709,073,620	36,800,372	745,873,992	16.8		
Pennsylvania Water & Power Company	20	494,624,400	None	494,624,400	11.1		
Consolidated Gas, Electric Light & Power Co. of Baltimore	27	190,415,747	239,295,100	429,710,847	9.7	429,710,847	None
Georgia Railway & Power Company	37	263,254,299	30,466,991	293,721,290	6.6	240,724,193	52,997,097
Potomac Electric Power Company	45	225,994,701	None	225,994,701	5.1	136,787,425	89,207,276
Virginia Railway & Power Company	48	208,517,000	None	208,517,000	4.7	156,082,000	52,435,000
Appalachian Power Company	58	137,000,000	11,700,000	148,700,000	3.3		
East North Central States:							
Commonwealth Edison Company	2	1,883,570,000	None	1,883,570,000	16.7		
Detroit Edison Company	9	1,002,283,600	22,400	1,002,306,000	8.9	856,000,000	146,306,000
Cleveland Electric Illuminating Company	15	682,557,097	None	682,557,097	5.5	520,000,000	162,557,097
Consumers Power Company	23	458,708,927	17,386,171	476,095,098	4.2	370,401,910	105,693,188
Michigan Northern Power Company	40	257,752,195	None	257,752,195	2.3	257,012,895	739,300
Northern Ohio Electric Corporation	42	213,825,011	33,284,952	247,109,963	2.2	185,277,974	61,831,989
Union Gas & Electric Company	43	234,634,375	None	234,634,375	2.1		
Toledo Railways & Light Company	49	65,682,760	142,147,850	207,830,610	1.8	179,177,053	28,653,557
Columbus Railway, Power & Light Company	56			153,626,000	1.4		
Acme Power Company	60	137,701,000	None	137,701,000	1.2		
Dayton Power & Light Company	62	129,618,270	None	129,618,270	1.1	122,982,095	6,636,175
Indianapolis Light & Heat Company	66	114,416,094	None	114,416,094	1.1	114,416,094	None
Indiana and Michigan Electric Company	70	103,693,910	None	103,693,910	0.9	103,693,910	None
West North Central States:							
Mississippi River Power Company	17	641,353,000	2,810,000	644,163,000	19.0		
North American Company (Missouri System)	25	163,832,003	307,779,044	471,611,047	13.9	302,658,115	168,952,932
North American Company (Wisconsin System)	31	323,415,493	75,204,251	398,619,744	11.7	366,884,619	31,735,125
Minneapolis General Electric Company	34	302,670,501	56,806,150	359,476,651	10.6	359,476,651	None
Great Northern Power Company	44	229,020,840	125,890	229,146,730	6.8		
Kansas City Power & Light Company	52	109,096,054	66,843,564	175,939,618	5.2	175,939,618	None
Empire District Electric Company	57	132,224,470	16,515,750	148,740,220	4.4	148,740,220	None
Nebraska Power Company	67	114,200,500	None	114,200,500	3.4		
East South Central States:							
Alabama Power Company	22	477,686,491	10,402,570	488,089,061	29.4		
Tennessee Power Company	28	428,649,835	None	428,649,835	25.8		
West South Central States:							
Texas Power & Light Company	55	159,939,831	None	159,939,831	12.7		
Mountain States:							
Montana Power Company	6	1,103,620,644	None	1,103,620,644	36.4	931,676,544	171,944,100
Utah Power & Light Company	19	519,854,000	None	519,854,000	17.9		
Idaho Power Company	51	184,843,000	None	184,843,000	6.1		
Colorado Power Company	64	116,707,472	40,820	116,748,292	3.8	116,748,292	None
Pacific States:							
Pacific Gas & Electric Company	3	1,349,615,458	126,063,215	1,475,678,673	24.5		
Southern California Edison Company	7	1,045,553,156	33,920,935	1,079,474,091	17.9	763,082,400	316,391,691
Puget Sound Power & Light Company	24	415,389,000	57,376,800	472,765,800	7.9		
Great Western Power Company	30	407,460,730	1,117,024	408,577,754	6.8	381,160,226	27,417,528
Washington Water Power Company	35	351,087,900	None	351,087,900	5.8	334,854,093	16,233,807
San Joaquin Light & Power Corporation	36	285,265,000	14,271,000	299,536,000	5.0	294,165,000	5,371,000
Portland Railway, Light & Power Company	38	292,023,900	295,071	292,318,971	4.9	223,799,000	68,519,971
Southern Sierras Power Co. & Nevada-California Power Co.	53	175,045,183	59,625	175,104,808	2.9	175,104,808	None
Los Angeles Bureau of Power & Light	54	169,489,210	None	169,489,210	2.8	169,489,210	None
California-Oregon Power Company	59	142,404,975	620,843	143,025,818	2.4	143,025,818	None
Tacoma Department of Light and Water	63	119,886,334	711,840	120,598,174	2.0	120,598,174	None
Northwestern Electric Company	68	110,103,594	2,722,495	112,736,089	1.9		
Canada:							
Shawinigan Water & Power Company	5	1,140,759,076	None	1,140,759,076	....		
Ontario Power Company	8	1,016,070,500	45,525,554	1,061,596,054	....		
Montreal Light, Heat & Power Consolidated	12	685,279,265	215,049,492	900,328,757	....	870,000,000	30,328,757
Toronto Power Company	16	649,748,800	None	649,748,800	....	561,573,800	88,175,000
Electric Railway Companies:							
Interborough Rapid Transit Company	1	816,603,610	None	816,603,610	....	None	816,603,610
West Penn Railways Company	2	498,353,000	26,623,000	524,976,000	....	None	524,976,000
Brooklyn Rapid Transit Company	3	401,492,451	88,256	489,748,451	....	None	489,748,451
Philadelphia Rapid Transit Company	4	125,879,870	223,147,464	349,027,334	....	None	349,027,334
Boston Elevated Railways Company	5	246,312,170	None	246,312,170	....	None	246,312,170
Pennsylvania R.R. Co., Long Island Power Plant	6	198,880,070	859,837	199,739,907	....	None	199,739,907
Kansas City Railways Company	7	189,172,898	None	189,172,898	....	70,807,706	118,365,192
New York Central Railroad Company	8	157,132,366	None	157,132,366	....		
Twin City Rapid Transit Company	9	139,711,248	None	139,711,248	....	None	139,711,248

Table II–Data on Output and Peak Load of Largest Generating and Distributing Systems in the United States and Canada

(This table includes all lighting, power and electric railway companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr.)

	Rank in 1920	1920			1919			1918			1917		
		Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)
Niagara Falls Power Company	1	303,640	Apr. 29	2,328,326,064	275,803	Dec. 29	2,034,608,904	254,139	Apr. 8	2,054,360,080	152,340	Aug. 1	1,188,221,770
Commonwealth Edison Company	2	478,820	Dec. 17	1,883,570,000	428,630	Dec. 15	1,628,340,000	400,010	Dec. 2	1,508,070,000	392,330	Dec. 28	1,488,080,000
Pacific Gas & Electric and Sierra & San Francisco Power Co	3	259,004	Dec. 22	1,475,678,673	244,732	.....	1,267,159,767	219,339	.....	1,168,797,446	203,542	.....	1,050,168,618
New York Edison and United Electric Light & Power Co	4	398,535	Dec. 6 and 22	1,383,070,086	330,210	Nov. 25	1,104,521,883	286,103	Dec. 11	958,878,156	278,097	Dec. 12	954,913,584
Shawinigan Water & Power Company	5	192,200	Nov. 17	1,140,759,076	172,900	Jan. 14	1,031,111,695	136,800	Sept. 24	1,058,136,117	119,000	Dec. 21	633,573,610
Montana Power Company	6	159,700	Aug. 7	1,103,620,644	133,500	June 13	865,998,552	157,800	Nov. 21	1,108,125,350	147,712	Jan. 11	947,732,014
Southern California Edison Company	7	213,450	July 12	1,079,474,091	200,020	July 23	1,021,977,519	163,125	July 12	779,758,000	166,755	Oct. 11	685,416,000
Ontario Power Company	8	152,000	Dec. 15	1,061,596,054	150,000	Nov. 12	949,223,500	119,000	Oct. 19	963,845,200	123,500	Nov. 11	990,086,100
Detroit Edison Company	9	218,800	June 16	1,002,306,000	210,000	Dec. 5	872,583,200	172,000	Dec. 13	773,876,700	152,300	Nov. 27	672,200,600
Public Service Electric Co. of New Jersey	10	216,452	Nov. 16	912,899,972	207,890	Dec. 16	821,355,239	185,738	Dec. 5	795,481,279	181,500	Nov. 27	734,665,649
Philadelphia Electric Company	11	203,624	Nov. 23	910,327,693	199,247	Dec. 18	722,615,280	166,294	Dec. 6	693,447,962	148,931	Nov. 20	600,583,589
Montreal Light, Heat & Power Consolidated	12	169,450	Nov. 17	900,328,757	164,415	Dec. 16	852,680,550	166,730	Dec. 6	976,462,529	152,665	Nov. 12	946,832,817
Duquesne Light Company	13	162,000	Jan. 29	810,401,406	157,900	Dec. 22	623,000,000	141,000	Dec. 6	641,874,585	125,000	Nov. 9	592,575,925
Southern Power Company	14	210,000	Nov. —	745,873,992	196,500	Dec. —	585,596,925	162,600	Dec. —	551,313,367	166,300	May —	563,533,763
Cleveland Electric Illuminating Company	15	155,041	Sept. 9	682,557,097	153,878	Dec. 5	576,131,649	128,319	Nov. 22	543,663,042	113,228	Nov. 27	444,735,309
Toronto Power Company	16	109,000	Dec. 21	649,748,800	115,000	Jan. 8	548,477,616	125,000	Dec. 3	897,512,877	118,000	Dec. 14	800,638,000
Mississippi River Power Company	17	115,650	Nov. 13	644,163,000	113,450	Nov. 18	590,488,000	102,950	Mar. 8	557,200,000	86,400	Oct. 31	476,500,000
Buffalo General Electric Company	18	108,500	Oct. 26	544,293,410	106,500	Nov. 22	508,583,680	104,100	Nov. 22	587,761,870	95,400	Dec. 6	440,596,100
Utah Power & Light Company	19	85,404	Nov. —	519,854,000	79,780	Jan. 14	461,531,633	81,313	Dec. 27	533,044,137	79,011	Dec. 21	502,183,000
Pennsylvania Water & Power Company	20	85,000	Very frequent	494,624,400	87,000	Nov. —	512,138,100	89,000	Feb. —	500,641,122	86,000	.....	516,891,000
Niagara, Lockport & Ontario Power Company	21	88,000	Jan. 6	492,466,460	.....	.....	.....	.....	.....	.....	.....	.....	.....
Alabama Power Company	22	97,900	Sept. 28	488,089,061	83,100	Jan. 10	347,993,284	86,850	Dec. 19	392,247,862	58,250	Nov. 14	289,715,125
Consumers' Power Company	23	106,924	May 19	476,095,098	108,847	Nov. 28	456,230,164	98,666	Nov. 21	404,412,000	94,235	.....	380,570,917
Puget Sound Power & Light Company	24	95,725	Dec. 3	472,765,800	93,900	Dec. 18	452,209,000	88,230	Dec. 20	427,800,000	83,800	Dec. 21	396,600,000
North American Company (Missouri System)	25	105,749	Dec. 21	471,611,047	99,498	Dec. 3	408,920,575	92,000	Nov. 26	395,820,236	92,300	Dec. 6	376,891,756
New England Power Company	26	103,450	Jan. 6	430,918,000	93,860	Dec. 9	357,303,224	76,900	Dec. 16	323,127,784	71,500	Oct. 30	300,600,000
Consolidated Gas, Electric Light & Pwr. Co. of Baltimore	27	88,990	Nov. 30	429,710,847	80,640	Dec. 5	392,201,280	82,760	Nov. 7	433,196,550	69,980	Dec. 4	343,523,580
Tennessee Power Company	28	74,800	Apr. 30-June 4	428,649,835	82,300	Feb. 14	422,272,590	87,800	Dec. 11	519,959,383	85,200	June 15	547,945,475
Pennsylvania Power & Light Company	29	87,685	Sept. —	411,639,501	81,435	Nov. —	342,071,900	69,100	Dec. —	310,151,400	.....	.....	.....
Great Western Power Company	30	80,600	July 27	408,577,754	48,000	May 12	213,189,992	45,780	.....	180,040,171	40,000	Oct. 24	180,583,920
North American Company (Wisconsin System)	31	90,347	Jan. 6	398,619,744	97,912	Dec. 4	331,874,192	87,855	Nov. 20	327,784,516	71,106	Nov. 30	275,966,740
Edison Electric Illuminating Co. of Boston	32	105,090	Dec. 9	395,076,738	103,136	Dec. 8	328,798,850	95,774	Dec. 6	293,966,604	83,966	Dec. 19	265,430,474
Brooklyn Edison Company	33	116,500	Nov. 30	382,963,027	105,400	Jan. 15	327,084,075	86,000	Dec. 11	282,424,822	78,000	Dec. 19	255,912,300
Minneapolis General Electric Company	34	78,010	Oct. 26	359,476,651	72,745	Oct. 24	332,264,401	66,189	Nov. 1	297,443,050	54,940	Dec. 6	222,146,210
Washington Water Power Company	35	63,955	Jan. 21	351,087,900	63,220	Dec. 3	241,761,350	33,956	Nov. 26	195,628,500	36,707	Dec. 20	188,311,100
San Joaquin Light & Power Corporation	36	47,180	Aug. 28	299,536,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Georgia Railway & Power Company	37	76,000	Apr. 9	293,721,290	71,700	Dec. 18	262,834,541	68,000	Nov. 8	238,489,012	78,200	Apr. 24	258,607,882
Portland Railway, Light & Power Company	38	62,600	Dec. 6	292,318,971	56,300	Dec. 22	271,600,300	56,900	Dec. 23	258,424,940	50,620	Dec. 31	218,086,315
Adirondack Power & Light Corporation	39	60,700	Dec. 2	277,100,000	66,000	Dec. 23	261,400,000	50,250	Nov. 8-Jan. 23	174,567,275	42,000	Dec. 7 & 14	158,570,164
Michigan Northern Power Company	40	35,408	Nov. 12	257,752,195	35,794	Apr. 23	264,272,468	33,519	Dec. 24	233,381,654	32,990	Dec. 3	221,538,757
Pennsylvania-Ohio Power & Light Company	41	48,900	Nov. 3	255,537,150	.....	.....	.....	.....	.....	.....	.....	.....	.....
Northern Ohio Electric Corporation	42	44,400	May —	247,109,963	.....	.....	.....	.....	.....	.....	.....	.....	.....
Union Gas & Electric Company	43	65,050	Dec. 21	234,634,375	.....	.....	.....	.....	.....	.....	.....	.....	.....
Great Northern Power Company	44	46,000	Apr. 20	229,146,730	48,000	May 12	213,189,992	45,780	.....	180,040,171	40,000	Oct. 24	180,583,920
Potomac Electric Power Company	45	62,000	Nov. 30	225,994,701	55,000	Dec. 17	204,008,647	48,000	Dec. 20	173,180,014	44,800	.....	140,762,646
Narragansett Electric Lighting Company	46	54,000	Jan. 5 & Nov. 16	213,232,000	57,000	Dec. 23	155,678,890	45,000	June 20	150,028,780	33,500	Dec. 19	113,238,441
Turners Falls Power & Light Company	47	55,500	May 27	212,926,530	.....	.....	.....	.....	.....	.....	.....	.....	.....
Virginia Railway & Power Company	48	46,150	Dec. 22	208,517,000	42,800	Dec. 18	181,280,000	35,700	Dec. 18	164,810,750	37,000	Dec. 8	153,128,026
Toledo Railways & Light Company	49	52,400	Mar. —	207,830,610	48,220	Dec. —	199,771,799	40,305	Dec. 4	161,103,970	37,627	Dec. —	162,061,232
Rochester Gas & Electric Corporation	50	49,400	Oct. 29	193,601,590	42,500	Dec. 2	172,892,249	52,300	Nov. 22	196,171,300	42,154	Dec. 13	162,490,264
Idaho Power Company	51	34,235	July —	184,843,000	27,090	Aug. —	154,754,000	24,350	Sept. —	134,355,000	.....	.....	.....
Kansas City Power & Light Company	52	35,500	Dec. 23	175,939,618	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern Sierras Power Co. & Nevada-Calif. Pwr. Co.	53	32,600	July 23	175,104,808	29,200	.....	165,782,785	28,200	Aug. 6	161,347,690	25,900	Aug. 9	148,267,885
Los Angeles Bureau of Power & Light	54	46,500	Dec. 29	169,489,210	24,650	Apr. 12	134,893,270	.....	.....	.....	.....	.....	.....
Texas Power & Light Company	55	33,620	Oct. 14	159,939,831	29,000	Nov. 7	121,212,000	28,800	Sept. —	118,850,000	.....	.....	.....
Columbus Railway, Power & Light Company	56	.....	.....	*153,626,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Empire District Electric Company	57	36,710	June —	148,740,220	32,030	Oct. —	130,114,100	25,400	Sept. 5	114,446,685	23,000	Apr. 1	105,487,860
Appalachian Power Company	58	35,300	Oct. —	148,700,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
California-Oregon Power Company	59	20,335	Jan. 28	143,025,818	.....	.....	.....	.....	.....	.....	.....	.....	.....
Acme Power Company	60	.....	.....	137,701,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Metropolitan Edison Company	61	28,000	Aug. 10	133,994,030	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dayton Power & Light Company	62	31,500	5/25 and 9/28	129,618,270	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tacoma Department of Light and Water	63	22,700	Nov. 10	120,598,174	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado Power Company	64	29,078	Oct. 1	116,748,292	.....	.....	.....	.....	.....	.....	.....	.....	.....
Scranton Electric Company	65	20,380	Jan. 8	110,225,212	.....	.....	.....	.....	.....	.....	.....	.....	.....

Indianapolis Light & Heat Company	66	27,240	Sept. 15		114,416,094				97,444,900	19,700	Dec. 18		74,708,000							
Nebraska Power Company	67	25,500	Nov. 26		114,200,500	22,600	Dec. 22													
Northwestern Electric Company	68	20,600	Dec. 10		112,736,089															
New Bedford Gas & Edison Light Co.	69	33,700	June 17		107,599,392															
Indiana & Michigan Electric Company	70	27,150	Nov. 9		103,693,910	23,100	Dec. 23		84,160,770	20,700	Dec. 15		81,625,432	18,800	Dec. 14		73,546,109			
Hartford Electric Light Company	71	32,500	Jan. 9		103,000,000															
Electric Railway Companies																				
Interborough Rapid Transit Company	1	242,020	Jan. 31		816,603,610	239,940	Dec. 19		810,158,475	204,000	Dec. 30		731,058,965	184,000	Dec. 11		689,665,975			
West Penn Railways Company	2	104,618	Nov. 24		524,976,000	94,130	Dec. 22		417,911,000	78,000	Dec. —		404,200,000							
Brooklyn Rapid Transit Company	3	111,147	Jan. 15		489,748,451	111,000	Dec. 16		406,130,443	109,892	Feb. 21		385,346,075	115,792	Feb. 2		396,068,887			
Philadelphia Rapid Transit Company	4	102,210	Jan. 14		349,027,334	101,120	Dec. 18		349,542,666	94,730	Dec. 27		339,232,739	103,220	Jan. 11		348,372,056			
Boston Elevated Railway Company	5	72,295	Jan. 14		246,312,170	71,760	Mar. 23		240,429,915	67,965	Mar. 23		228,131,265	79,535	Feb. 12		262,920,065			
Pennsylvania R.R. Co., Long Island Power Plant	6	55,200	Jan. 5		199,737,907	53,900	Dec. 19		181,017,940	48,600	Jan. 3		165,377,180	45,000	Dec. 10		161,673,710			
Kansas City Railways Company	7	51,740	Jan. 8		189,172,898	49,430	Oct. 27		211,707,571	52,280	Jan. 11		209,378,747	61,350	Feb. 2		236,675,814			
New York Central Railroad Company	8	46,440	Dec. 27		157,132,366	44,100	Dec. 29		140,435,406	38,360	Jan. 22		127,412,457	42,480	Dec. 10		147,809,842			
Twin City Rapid Transit Company	9	42,700	Dec. 21		139,711,248	42,612	Nov. 28		133,676,028	44,966	Feb. 19		131,351,288	51,956	Mar. 31		152,469,348			

* Estimated for four months of 1920. Blank indicates that no report covering year was received from company.

panies as well. Such conditions do not tend to produce large municipal plants with great outputs. It is of interest to the student of the problem to study the source of the electrical energy which is distributed by these larger companies. Statistics of the industry compiled since electrical energy became one of the chief sources of power indicate that as the number of large generating stations has increased and long high-tension transmission lines have been extended over wide areas there has normally been an increasing tendency for small plants to discard their generating equipment and purchase energy from the larger and more economically operated systems. Many new stations have been installed of which the sole function is to distribute to customers the energy produced by others. It is evident from the data in Table I that this tendency toward functioning as a distributing company rather than as both a generating and distributing company has gained considerable headway among the larger systems of the country. The extent to which the large companies are purchasing power for distribution to their customers is rather surprising. Of the sixty-six American light and power companies, only twenty-four do not purchase energy and only six purchase more energy than they generate in their own plants. Of the nine electric railway companies listed only four purchased a portion of their energy and only one purchased more energy than it generated. In years past most companies have purchased power from other public utilities only at irregular intervals when there was an abnormal request for energy beyond the rating of their own generating stations. The accompanying tabulation would indicate that such an arrangement is now rather the exception than the rule and that a majority of the large electric distributing companies are purchasing a high percentage of their total output. Two possible causes for these conditions are applicable. First, many of these companies are able to purchase a large portion of their power from other public utilities cheaper than they can generate it themselves, owing to the facilities for cheap development in the locality, such as water power, having been acquired by other generating companies. Second, a comparatively high initial investment in plant and equipment of various kinds is needed to generate the additional power which is purchased. In the first case the arrangement is permanent, while in the second case a lowering in construction and equipment prices as well as a more favorable money market, including a lower rate of interest, will undoubtedly enable a large portion of these companies to construct additional units on their systems and to curtail their purchased power to enough for emergencies only. It is estimated that at the present time the central generating plants of this country are deficient in generating units to the extent of about 2,800,000 kw. Many companies indicate that they intend making large extensions to their generating equipment just as soon as prices and the industrial conditions warrant.

A few companies were unable to report their output as distributed between that sold for light and power purposes and that sold to electric railways. From those making such a distribution, however, it is possible to state that about three out of every four generating systems sell a portion of their power to electric railways. In most cases the energy sold to electric railways is less than 12 per cent of the total output, but some of the larger companies, such as the Southern California Edison Company, report a distribution of from 25 to 30 per cent of their total output to electric railways.

Reports from electric railway generating plants indicate that only nine such plants generated more than 100,000,000 kw.-hr. in 1920. Only one of these companies sold a small portion of its energy to electric light and power customers. With but two exceptions all these companies are operating in the New England and Middle Atlantic states. With the exception of the Interborough Rapid Transit Company, operating in Greater New York, and the West Penn Railway Company, operating in the Pittsburgh district, none of the electric railway companies shows such large gains in output during the past four years as are shown by practically all the large electric light and power companies. The electrical energy consumed by electric railways varies to a large extent directly as the population of the territory served, while the electrical energy distributed by electric light and power companies varies not only with the population but also with the extent to which that population is converted to the use of electricity both for light and power. It should be noted, however, that the peak load of the electric railway companies increased in every instance over that reported for 1919, and that the dates of the peak loads all occurred within thirty days of one another, with the exception of that reported by the West Penn Railway Company.

Testing for Phase Rotation in Three-Phase Circuits

In Field Measurements It Is Often Necessary to Determine Whether Current Is Leading or Lagging—Methods Requiring Little or No Auxiliary Apparatus

BY F. A. KARTAK
Formerly Director Standards Laboratory, University of Wisconsin

IN PREVIOUS articles in these columns by H. M. Crothers and the writer* relating to the testing of instrument transformers use was made of voltages and currents displaced in phase in connection with the determination of instrument-transformer phase angles. In the case of field testing work the suggestion was made that adjacent phases of a three-phase system be used for voltage and current circuits, thus giving a power factor of approximately 50 per cent. It was further assumed that the tester has means of knowing whether the power factor so obtained is lagging or leading, that is, whether the current is lagging or leading the voltage in phase position.

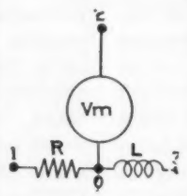
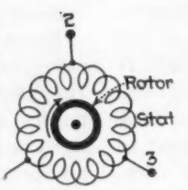
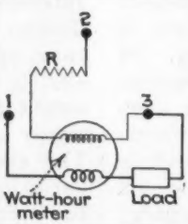
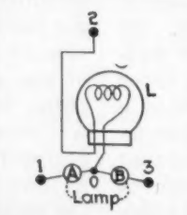
Some of the field methods of testing for phase rotation to ascertain whether the power factor is leading or lagging which have been used by the standards laboratory of the University of Wisconsin are shown in the table, which includes most of the necessary information, references to the original articles describing them being also indicated. This table gives specific directions for obtaining lagging current at 50 per cent power factor, but the methods are suitable for broad application in determining phase rotation.

The miniature three-phase induction motor called for in method No. 2, which is shown at (*a*) in the figure, may be conveniently carried in a meterman's tool kit. By connecting the terminals of the stator to the leads of the three-phase power supply the direction of rotation of the squirrel-cage rotor indicates directly the direction of phase rotation. The only objection to this method is that the meterman is required to carry this additional apparatus.

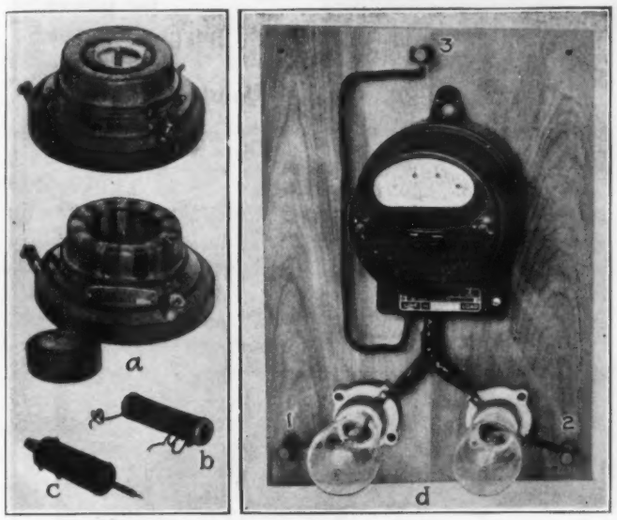
In method No. 1 the resistance and reactance of equal

*See ELECTRICAL WORLD, March 15 and July 19, 1919, and Feb. 7 and June 12, 1920.

Classification of Methods of Testing for Phase Rotation

METHOD No.	METHOD DESCRIPTION	APPARATUS REQUIRED	CONNECTIONS	FOR LAGGING CURRENT 50 PER CENT POWER FACTOR CONNECT METER CIRCUITS AS FOLLOWS:	REFERENCES
1	Resistance—Reactance—Voltmeter Method	Resistance and reactance of equal value Indicating voltmeter with range 1.4 times line voltage		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if voltmeter indicates approximately 137 per cent of line voltage	W. V. Lyon El. Wld. Vol. 69, p. 968 May 19, 1917
2	Induction Motor Method	Miniature squirrel-cage rotor induction motor		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if rotation is in the direction 1 — 2 — 3	
3	Watt-hour Meter-Resistance Method	Single phase induction watt-hour meter High non-inductive resistance (about 10,000 ohms for 110 volt circuits)		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if meter operates faster when voltage circuit is connected across phase (2 — 3) than when connected across phase (1 — 2)	R. S. Brown El. Wld. Vol. 63 p. 144 Jan. 17, 1914
4	Lamp and Inductance Method	Two incandescent electric lamps of equal voltage and wattage rating One high reactance coil (voltage circuit of induction watt-hour meter)		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if lamp (A) is brighter than lamp (B)	T. W. Varley El. Wld. Vol. 69, p. 466 Mar. 10, 1917

value are connected in series across one phase and a voltmeter is connected from their common junction to the third phase wire. If the voltmeter indicates approximately 37 per cent of the line voltage, phase 1-2 leads phase 2-3 by 120 deg. If the voltmeter indicates approximately 137 per cent of line voltage, phase 1-2 lags the phase 2-3. The only objection to the use of this method is that it also requires a meterman to carry additional equipment.



DEVICES USED FOR DETERMINING PHASE ROTATION AS SHOWN IN TABLE

(a) Miniature induction motor (method 2). *(b)* and *(c)* Convenient non-inductive resistances (method 3). *(d)* Lamp and meter scheme has the advantage that this equipment need not be carried, but may be obtained wherever tests are made.

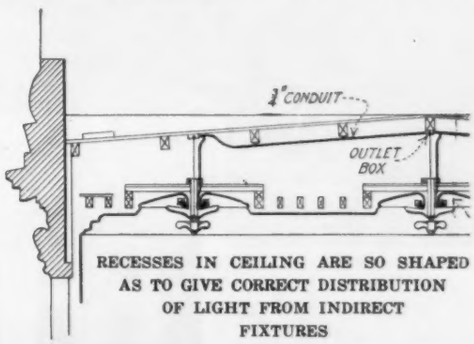
Method 3 requires only the use of a non-inductive resistor of high value (about 10,000 ohms for 110-volt circuits), such as shown at (*b*) or (*c*) in the figure. By testing the service watt-hour meter in the usual manner with a portable standard watt-hour meter, after connecting the high resistance in series with the voltage circuit of the service meter and after connecting the voltage and current circuits of the meter to adjacent phases of the power supply, the 50 per cent lagging power-factor connection is the one which shows the service meter to be operating the slower in the two tests. While this method requires the meterman to carry only a small resistor, which may be of the Ward-Leonard enameled type or may consist of a short fiber tube packed with powdered chalk and carbon dust as shown at (*b*) and (*c*), it is not extremely satisfactory in that it requires the meterman to set up and make two test runs before he is certain his connection is the correct one.

Method 4 is now being used and recommended by the standards laboratory since it requires the use of only such equipment as the meter tester always carries with him or can find available at almost every installation. By connecting in star to the three-phase supply leads two similar incandescent electric lamps and a reactor (such as the voltage circuit of the service meter or the portable standard watt-hour meter) it will be observed that the filament of one lamp will operate more brightly than that of the other, depending upon the direction of phase rotation. A 50 per cent lagging power factor is obtained by connecting the current coil or load circuit of the meters to the phase to which are connected the two lamps, and the voltage circuit of the meter to the phase terminals to which are connected the bright lamp and the meter coil. At (*d*) is shown all of the equipment necessary for making a test of this kind, this equipment as shown having been assembled for use about the laboratory.

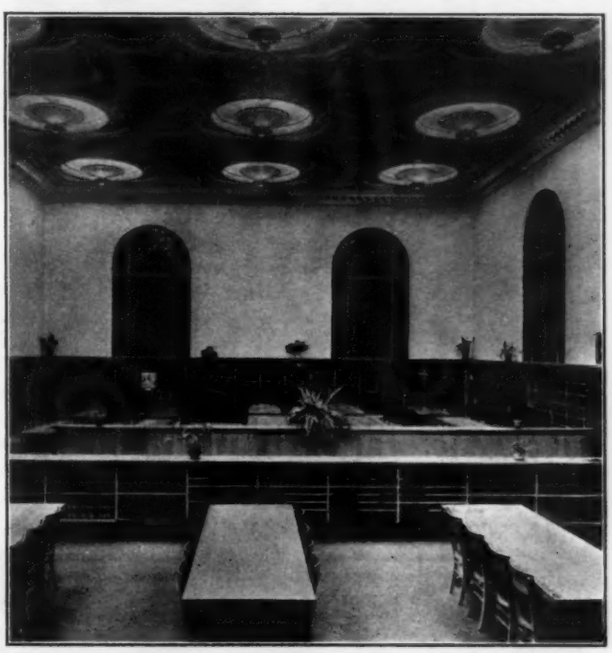
Indirect Ceiling Fixtures Provide Even Illumination for Library

EVENLY distributed and adequate illumination has been obtained for a large library on the Pacific Coast by indirect lighting fixtures mounted close to recesses in the ceiling. These recesses are shaped to provide the correct distribution of light. So well was the design carried out that practically no shadows were formed on the floor, and the illumination produced is practically ideal for the purpose for which it is intended.

The lamp bulbs are supplied from a circuit carried in a ¾-in. (18-mm.) conduit fastened to the beams of the upper ceiling, taps being taken off of the line at points directly above the lighting fixtures. A good idea of the wiring construction may be obtained from the cross-section through these ceiling recesses. From the half-tone the excellent distribution of light can be readily seen.



RECESSES IN CEILING ARE SO SHAPED AS TO GIVE CORRECT DISTRIBUTION OF LIGHT FROM INDIRECT FIXTURES

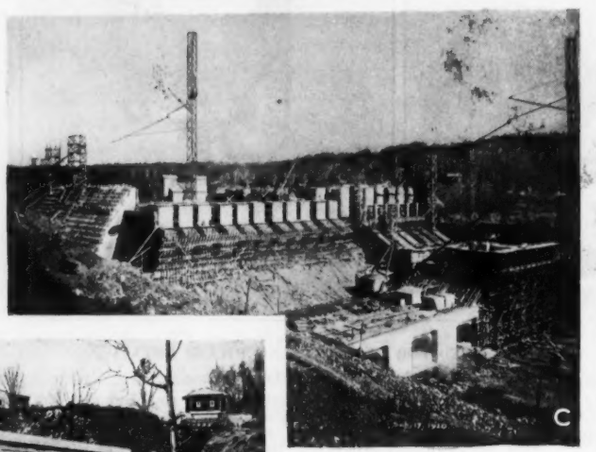


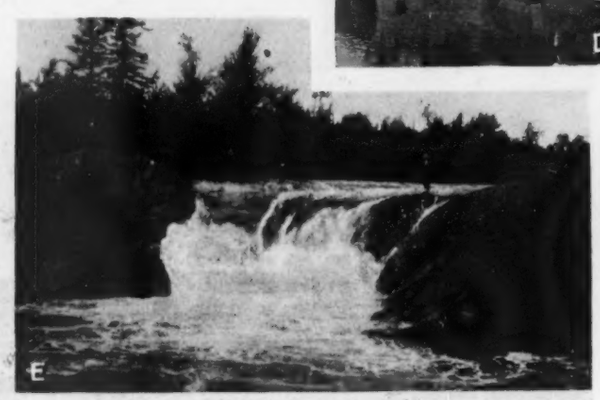
INDIRECT FIXTURES GIVE ADEQUATE ILLUMINATION IN THIS LIBRARY

Canadian Developments Now 274 Hp. per 1,000 of Population

One feature of Canadian progress has been the development of numerous small plants for industrial purposes

There are many undeveloped sites that will be available for power purposes as the needs of the Dominion increase





A — Whitemund Falls, Nelson River, Manitoba, an undeveloped site.

B—St. Margaret's Bay development on the Northeast and Indian Rivers, Nova Scotia, which will serve the city of Halifax.

C—Cameron Falls plant on the Nipigon River, Ontario, which is a part of the Ontario Hydro-Electric Power Commission's development serving the Thunder Bay system.

D—High Falls development in the Mississippi River in Ontario, showing power house, penstock and gatehouse. This is a part of the Rideau system, Ontario Hydro-Electric Power Commission.

E—A possible site on the Nahave River in Nova Scotia, known as Indian Falls.

F—Ragged Falls on the Sepreaun River, New Brunswick, which offers possibilities as a future development. There is also another important site at Big Falls.

G—The second pitch of the Grand du Bonnet Falls, Winnipeg River, Manitoba. This part of the river is now in the process of development by the Winnipeg Power Company and will total initially 56,000 hp. with an ultimate capacity of 168,000 hp. Slave Falls is also another possible site for power development on the Winnipeg River.

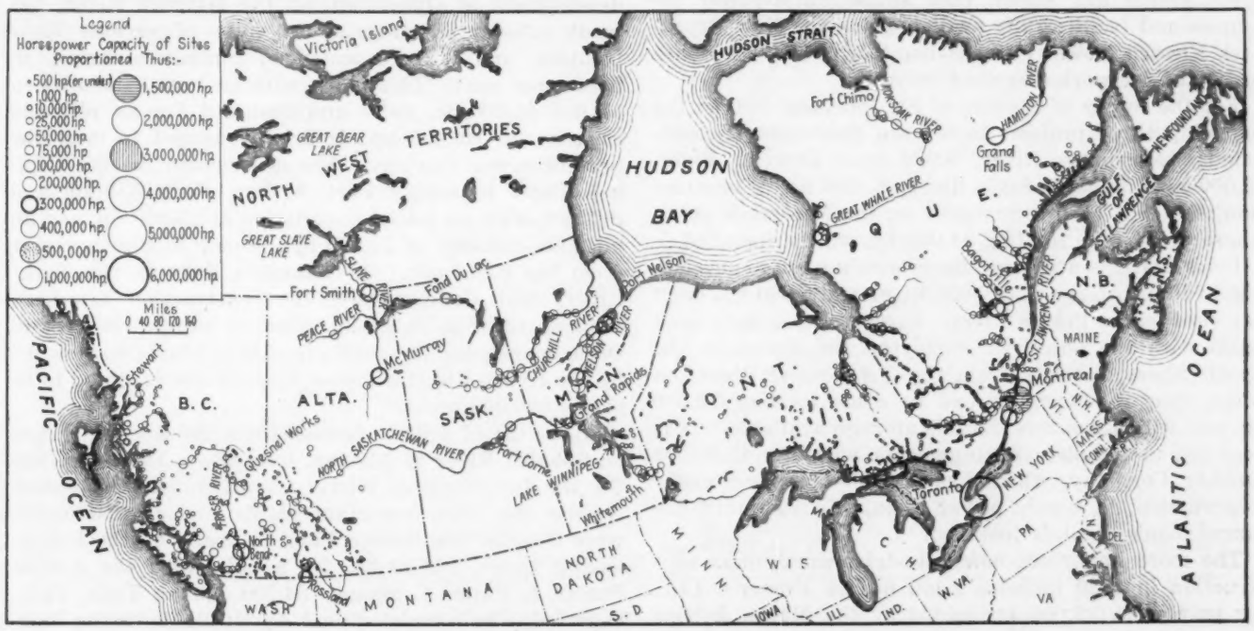
Canada Shows Rapid Hydro Development

Work Completed or Under Way During 1920 Totals 650,000 Hp.—Total Developments of the Dominion Now Stand at 2,460,000 Hp.—Ontario Shows the Greatest Progress

By J. B. CHALLIS

Director of Water Power Dominion of Canada, Ottawa, Ont.

IN SPITE of the outstanding facts that financial and commercial conditions are still far from normal and that costs of construction are prohibitive for all but absolutely necessary undertakings, a review of the year's work in hydro-electric matters in Canada shows considerable progress and encouragement for the future. The total development work completed or under construction in 1920 represented approximately 650,000 hp. of installed capacity. The total developed hydro-electric power in the Dominion now stands at 2,460,000 hp. Taking the population at 9,000,000 (estimate tabled in the House of Commons April 6, 1920), the development per 1,000 of population is 274 hp., a figure far ahead of the United States and ahead of any other country in the world except Norway.



POSSIBLE SITES FOR WATER POWER IN CANADA, SHOWING THE ESTIMATED CAPACITY

The Province of Ontario still leads in magnitude of development under construction, the total being approximately 500,000 hp. during 1920. The Province of Quebec comes next in order of development activity, while Nova Scotia and New Brunswick have entered on an active policy of provincial government development of their water-power resources. Great activity has also been shown in organized general hydrometric investigation and the planning of further development. With the exception of Quebec, all of this work has been transferred to or co-ordinated by the Dominion Water Power Branch. On July 19, 1920, the Hydrometric Survey of Canada was established by Dominion order-in-council, the work to be conducted under the supervision of the Director of Water Power. Previously there had been some confusion existing between the work carried on in the various provinces and that done by the central government. Arrangements have also been reached with the Quebec authorities so that all preliminary investigatory work will be standardized and the results co-ordinated with those of the other provinces.

Reviewing the development work in Nova Scotia in 1920, it has been shown that this province contains a number of conveniently located and economic sites, that the development work under construction represented over 15,000 installed hp., and that a good start has been made on organized and systematic development.

The first projects undertaken by the Nova Scotia Power Commission and commenced in 1920 were the St. Margaret's Bay development, to supply the city of Halifax, and a hydro-electric system for the county of Lunenburg. The St. Margaret's Bay development is the first hydro-electric plant of considerable size in the province. It consists of two separate generating stations—the Tidewater generating station, at the head of St. Margaret's Bay near the mouth of Northeast River, designed to give 6,900 hp., and the Mill Lake generating station, on Northeast River, to give 3,920 hp., a present total for the two stations of 10,820 hp., with an ultimate capacity of 15,000 hp. Storage is also under construction at several points. These developments are intended to supply the city of Halifax, and it is expected that some power will be available next August.

The Lunenburg system is designed to supply Mahone,

Lunenburg, Riverport and other communities in that county. An existing plant on the Mushamush River has been taken over and extended, plans are practically completed for a new development, and a third is being considered, so that the water of this river may be used three times.

Other considerable plans are in hand by the commission, though not yet actually under construction, including the Sheet Harbor project, with an installation of 25,000 hp., to supply New Glasgow, Stellarton, Trenton and other places, and the industries of Pictou County, and the Bear River project for stations of 1,200 hp. and 7,500 hp. to supply Digby and other towns and projected industries. Among industrial concerns, the Sissiboo Pulp & Paper Company installed 2,600 hp. and other companies about 1,700 hp., of which part was for both industrial and utility purposes.

PROGRESS IN NEW BRUNSWICK

In New Brunswick progress in 1920 consisted of more than 18,000 hp. installed or under construction with a number of developments in immediate prospect. Expert investigation has shown that ample water-power resources and facilities are available, and the New Brunswick Electric Power Commission (formed in 1920) has instituted the work described below.

For the supply of the city of St. John and district the following three projects have been thoroughly investigated: Musquash River, 8,000 hp.; Lepreau River, 12,000 hp.; Magaguadavis River, 15,000 hp. Construction work has been commenced on the Musquash plant, where three units totaling 11,000 hp. will be installed.

Investigations are being made with a view to developing 8,000 hp. on the Shogomoc River and 8,000 hp. from two sites on the Pokick River. Investigations have been made with the object of supplying the towns in the North Shore districts from the Tetagouche River, on which four developments can be made totaling 10,000 hp. and which has considerable storage available. It is expected to complete arrangements with the Bathurst Lumber Company, which has a 9,000-hp. plant under construction, to supply power to this district until the commission's plant is installed.

The more important new industrial work under construction in 1920 includes 2,400 hp. by Fraser's, Ltd., for pulp work; 2,000 hp. added by the Maine & New Brunswick Power Company; 3,000 hp. by Canadian Cottons, Ltd., and 9,000 hp. by the Bathurst Lumber Company.

Among the principal undertakings either completed or commenced in Quebec during the year were those of the Cedar Rapids Company, 21,600 hp.; the Shawinigan Company, 42,000 hp.; the Laurentide Company, 42,000 hp.; the Lothiniere Lumber Company, 1,680 hp.; La Corporation d'Energie de Montmagny, 3,600 hp.; Price Brothers & Company, Chicoutimi, 17,600 hp.; city of Rivière du Loup, 525 hp.; Southern Canada Power Company, Drummondville, 7,000 hp., and Canadian Consolidated Rubber Company, St. Jerome, 450 hp. The total new power development work approximated 137,000 hp., and a number of other large projects seem assured of commencement in the coming season.

ONTARIO SHOWS LARGEST DEVELOPMENT

In pursuance of the co-operative agreement made in 1919 between the Hydro-Electric Power Commission of Ontario and the Department of the Interior, the Dominion Water Power Branch is now responsible for all basic investigation respecting water resources, while the province undertakes the detailed investigation for and construction of actual developments. Under the agreement a special bureau of the Dominion Water Power Branch has been formed to deal with the work, with headquarters at Ottawa; the stream measurement and investigatory studies have been largely extended, and a very thorough inventory and analysis of developed and undeveloped water-power and storage resources is in course of preparation.

Among the important investigatory work that falls naturally under the heading "Ontario," and to which much time and labor have been devoted during the past year, there may be mentioned the studies on the St. Lawrence River and on the regulation of the Lake of the Woods for storage purposes.

The installation of two new units of 20,000 hp. each by the Hydro-Electric Power Commission in the plant formerly owned by the Ontario Power Company at Niagara Falls, and of a 3,500-hp. plant at High Falls on the Mississippi River, near Perth, to supply the Rideau System, were completed in 1920. The great development at Queenston, on the Niagara River, has made substantial progress in spite of serious labor troubles, and it is expected to commence supply in September next. This plant, with an initial installation of five 60,000-hp. units and designed for an ultimate capacity of 540,000 hp., is greatly needed to meet the present power shortage. The development on the Nipigon River to supply Port Arthur, Fort William and district, with an initial installation at 25,000 hp. and an ultimate capacity of 75,000 hp., is now supplying power from the first unit. At Ranney's Falls in the Trent River, near Campbellford, the construction has been commenced of a 10,000-hp. plant to supply the central Ontario system. The total capacity of plants now owned by the Hydro-Electric Power Commission is stated to be over 1,000,000 hp.

In the list of private developments the Big Eddy Dam on Spanish River at Algoma, to create a 15,000-hp. site for the International Nickel Company, was completed. Among the more important plants under construction were those of the Spruce Falls Company on the Kapuskasing River, 11,600 hp. for a pulp mill; the Abitibi Power & Paper Company, 24,000 hp. at Twin Falls, expected to be completed next April; plants on the Sturgeon River and Vermilion River by the Spanish River Pulp & Paper Company; an extension of 9,000 hp. by the Great Lakes Power Company at Sault Ste. Marie; a plant of 4,500 hp. by Canadian Cottons, Ltd., on the Cornwall Canal, and others.

It will thus be seen that in Ontario in 1920 there was approximately 500,000 hp. of hydro-electric development under construction.

WINNIPEG DEVELOPMENTS MOST IMPORTANT IN MANITOBA

The city of Winnipeg's hydro-electric plant at Point du Bois, on the Winnipeg River, consisted at the end of 1919 of eight units totaling 46,400 hp., the headworks and draft tubes being completed for an additional eight units. Early in 1920 contracts were let for extensions to the power house and for three additional units of 6,900 hp. each, at a total cost of $300,000 and to be completed by Sept. 1, 1921. An additional transmission line at a cost of $700,000 is now nearing completion. The total capacity of this plant will then be 67,100 hp. The ultimate capacity is sixteen units, totaling more

than 100,000 hp. The Winnipeg Electric Railway Company, which gives a general electric light and power supply in addition to operating the street railway, has a plant on the Pinawa Channel of the Winnipeg River of which the capacity was 28,200 hp. Recent improvements to the channel, increasing the head, and improvements to the plant have increased the maximum capacity to 37,600 hp. This company also controls a further development under construction on the same river, referred to below under the head of the Winnipeg River Power Company.

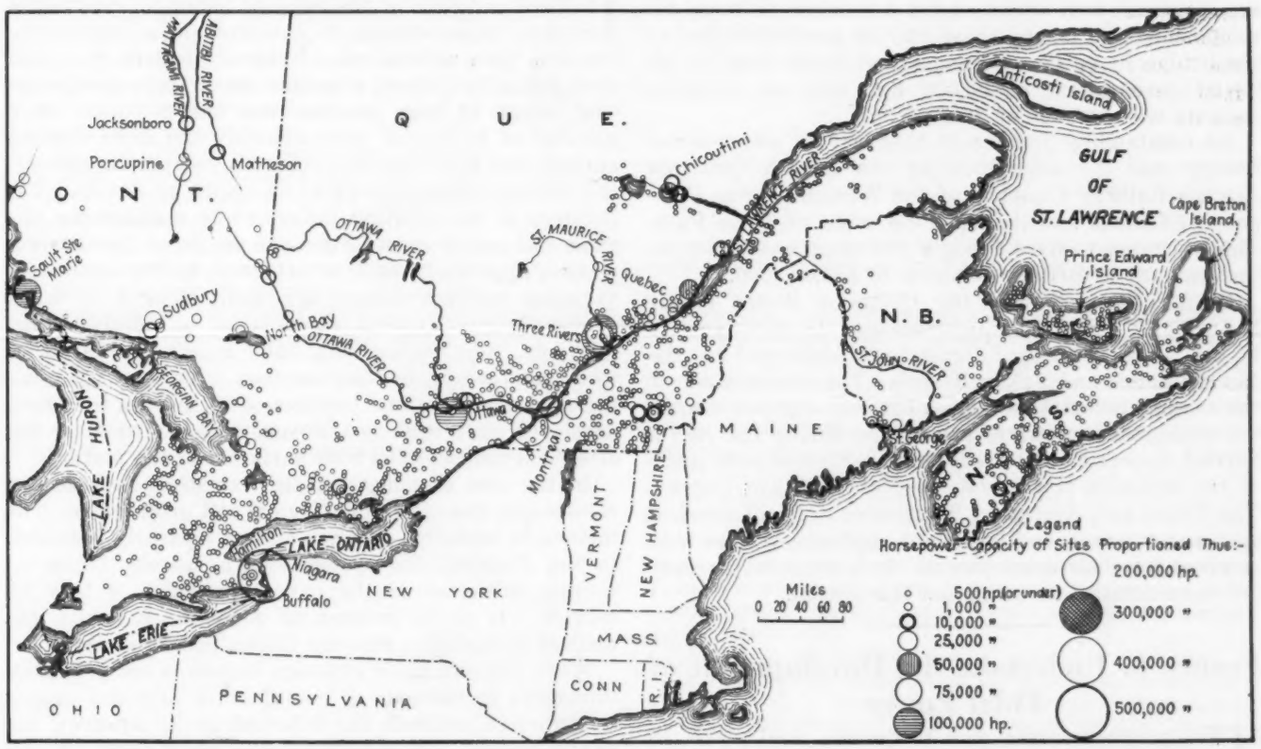
It is of interest to note that the combined efforts of the city and the Winnipeg Electric Railway Company to supply electric power at low rates have borne marked results in the development of manufacturing industries. In number of factories and value of product Winnipeg now ranks as the fourth manufacturing city in Canada, and in the consumption of electric energy per annum, per head of population (823 kw.-hr.) it is surpassed by few cities in the world.

It should also be noted that the power available from the Winnipeg River exceeds 400,000 minimum twenty-four-hour continuous horsepower from nine sites within 80 miles (129 km.) of Winnipeg, sufficient to meet all requirements for many years to come.

The Winnipeg River Power Company has commenced construction on a site at Lac du Bonnet on the Winnipeg River designed for an initial development of 56,000 hp. and an ultimate capacity of 168,000 hp.

The Manitoba Power Commission, created by the electrical power transmission act of 1919, was formed for the purpose of distributing electrical energy throughout the province, and it was authorized either to purchase or to generate power for the supply of any community where this was economically feasible. The intention was not to confine operations to water power, but where it was more advisable to supply fuel-generated power to groups of communities linked up to separate systems and so to design each such system that it might eventually become a link in the general provincial system. The commission immediately undertook the supply of power to Portage la Prairie, 56 miles (90 km.) from Winnipeg, the power to be purchased in bulk from the hydro-electric plant of the city of Winnipeg, transmitted at 66,000 volts by the commission and delivered in bulk to Portage la Prairie.

Since that date the operations of the commission have developed with considerable rapidity along broad but conservative lines. Power was turned on to the Portage la Prairie line on Aug. 16, 1920, and in the meantime the matter of supplying other municipalities in central and southern Manitoba was investigated and in a number of cases undertaken. During the year the construc-



EXTENSIVE WATER-POWER DEVELOPMENTS ARE SHOWN IN THE EASTERN INDUSTRIAL SECTION OF THE DOMINION

tion of transmission lines was commenced to the municipalities of Roland, Carman, Morden, Oakville, Winkler, Manitou and Gladstone, involving a transmission network of some 175 miles (281 km.), and investigations were also carried on with a view to supplying Emerson, Oakville, Rollin, Minnedosa, Virden and other municipalities that had petitioned for a supply.

While no actual development has occurred in Saskatchewan during the year, considerable progress has been made in organization of the large and important project to divert and elevate water from the South Saskatchewan River for supply to Moose Jaw, Regina and other cities and towns throughout the dry belt of south Saskatchewan.

No developments have taken place in the Province of Alberta during 1920, but the future possibilities are large and promising. The Peace, Athabasca and Slave Rivers in the north possess a number of excellent power sites, and the apparently imminent mineral developments in that region will probably lead to early development of some of these water powers for which applications have

already been received. Investigations are being made with a view to increasing the storage for the Bow River developments and also with respect to power projects in the Spray Lake district.

In British Columbia also the basic work of investigation is carried out by the Dominion Water Power Branch under a co-operative agreement with the Provincial Water Rights Branch, in force since 1913, and in view of the large amount of data and length of period these investigations cover, a comprehensive summary and analysis of the water-power resources of the province was commenced in 1920.

While these resources, estimated at 3,000,000 hp., include many accessible and favorable sites, the actual construction work in 1920 was in comparatively small units for individual mines and other purposes. Plans are, however, well advanced for a number of large developments, and among these may be mentioned that of the Bridge River Power Company at Seton Lake for an initial development of 50,000 hp., with an ultimate capacity with storage of 360,000 hp.

An outstanding feature of the year in water-power history was the acquisition by the British Columbia Electric Railway Company of the Western Power Company of Canada and its 39,000-hp. plant at Stave Falls. This is stated to have brought the total investment of the company in British Columbia to $65,000,000.

During the past year the Dominion Water Power Branch took over the administration of the water powers in the Yukon Territory formerly administered by the Mining Lands and Yukon Branch. The development of the mining industry is almost entirely dependent upon the development of water power, and during the year a hurried inspection and preliminary estimates were made of the available power resources in the Mayo district. The Yukon and Northwest Territories are well supplied with water power, and important applications have been received for their development. It is intended to carry out more detailed investigation this season.

France to Undertake the Development of Tidal Power

THE much-discussed plan to develop tidal power in France has been brought nearer to realization by the inclusion in the budget of the Minister of Public Works of an item appropriating 2,500,000 francs for the construction of machinery at the mouth of the Rance River with this object in view. The plan is simple. The Rance has a 30-ft. tide. Enormous reservoirs will be constructed into and out of which tide water will flow through openings holding turbines. When the tide rises the turbines will turn, and when the tide runs out they will also be kept in revolution.

"France must use all her natural forces," the Minister of Public Works said in support of the proposed appropriation. "To the white coal of our mountains and the green coal of our fields we are going to add the blue coal which the length of our seaboard renders available to an enormous extent." He added that the work of construction would be done by a French firm, and that he had already received applications for concessions of power. He said soundings were now going on at the mouth of the Rance with a view to starting work on the reservoirs.

The most difficult task of the French engineers was to perfect a turbine which would work reliably under water and which would turn with great quickness in response to a comparatively slow movement. It is understood that the most important part of the construction will consist of three reservoirs formed by walls 500 yd. long and 25 yd. high, measured from the bed of the river. The Minister said that he expected the Rance plant to develop 30,000 hp. or 40,000 hp.

Redesigned Stirling Boilers to Have Fewer Classes

Reclassification and Standardization that Simplifies Tube Lengths, Drum Locations and Other Fundamental Elements

IN THE redesign of the Stirling boiler to incorporate certain improvements in construction a reclassification has been worked out. Formerly boilers were sold very generally to meet a specific set of space conditions. The result of that practice was the evolution of a number of boilers of approximately the same heating surface, but with radically different over-all dimensions, the different units coming to be known as classes. The builders of the Stirling boiler, while maintaining the same features of construction and design in the different classes, apparently paid no attention to the method of variation between classes, the result being a series of classes having little in common as to relative drum locations, tube inclinations, tube lengths or ratios of grate surface or heating surface. An accompanying figure shows in outline fourteen of the classes that were developed under this system superimposed one over the other and indicates the wide variation in the features.

In the new classification the variation between the classes and sizes is simple, logical and progressive. The method in variation between classes is clearly indicated in the drawing, the system shown thereby being, of course, unlimited in the extent to which it may be carried. It is of interest to compare this with the method of variation between classes hitherto used.

While the purchaser of steam boilers is not primarily interested in methods of manufacture provided proper construction methods are followed, it is, however, the purchaser who ultimately receives the benefit of any improvements in manufacturing methods. The reclassification of the Stirling boiler will undoubtedly lead to a reduction in manufacturing cost.

The reduction in manufacturing cost that will result from the reclassification will come about through a reduction in inventory of material that must be carried and in the number of standards in use, the greater number of parts applicable to the large proportion of the boilers built, the interchangeability of such parts, the manufacturers' ability to build more nearly for stock and through an increase in flexibility of output and ability to make quicker shipments.

Although the manufacturer of this boiler will offer previous standards to complete plants in which such standards were installed, it is the intention to offer the redesigned and reclassified boilers for all new work.

The principal improvements in design over the boiler hitherto offered are stated in the following paragraphs:

First—All steam drums are now placed on the same level, the steam being taken from the rear steam drum.

The steam and water circulating tubes which come between the drums are designed and proportioned on the basis of numerous tests made under service conditions, the

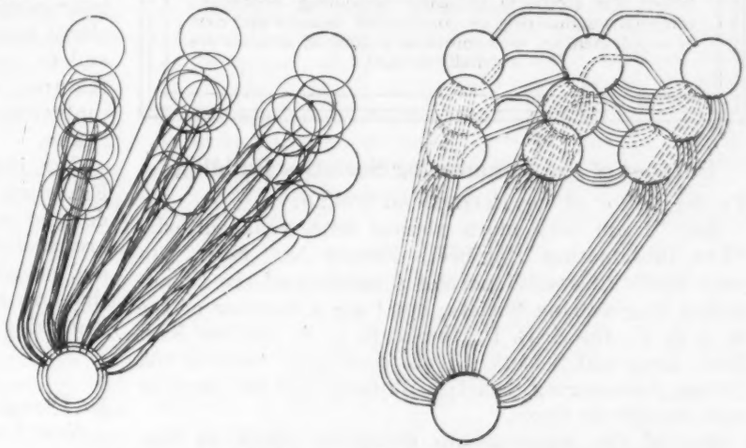
necessary degree of restriction to the flow of steam and water which they give being such that highly concentrated water can be handled without involving priming difficulties.

Within recent years there has been a marked improvement in furnace and stoker design, and combustion rates are possible today greatly in excess of what was believed possible a few years back. These increased combustion rates, together with the enhanced cost of fuel and the resulting necessity for obtaining a greater output in the way of steam production from a given amount of capital tied up in boiler and stoker equipment, have led to a gradual and increasing tendency toward higher boiler capacities.

At the higher capacities the length of time necessary for the degree of concentration of salts in the water within the boiler to build up to an objectionable point was correspondingly diminished, and some feed waters that could be readily handled at low capacities began to give trouble through priming unless the amount of blowdown was excessive. Although great advances have been made in a relatively few years in the treatment of boiler-feed water, many plants have not installed the equipment necessary for such treatment, and priming difficulties, while not general, have been encountered where feed-water conditions were bad or the load was widely and suddenly fluctuating.

Numerous experiments were made to overcome priming troubles under the special conditions encountered, with the result that in the redesigned Stirling boiler the steam is taken from the rear drum, which is raised to the level of the center steam drum. This construction enables a degree of concentration to be carried in the redesigned boiler that would undoubtedly lead in certain instances to priming with a center-drum steam outlet. The change has been made, not with any idea of advocating higher degrees of concentration than are now usual, but in order to take care of conditions under which, because of feed-water conditions, concentration unavoidably builds up rapidly.

Second—Protection of the rear steam drum is given by a baffle carried on the front tube of the rear bank, which is expanded into the center drum. In the earlier designs such protection was given either by a baffle carried on water circulators between the middle and rear drums or by the use of heavy, cumbersome and expensive cast-iron plates.



SUPERIMPOSED OUTLINE OF FOURTEEN OF THE OLD CLASSES OF STIRLING BOILERS (LEFT) AS COMPARED WITH THE NEW CLASSES

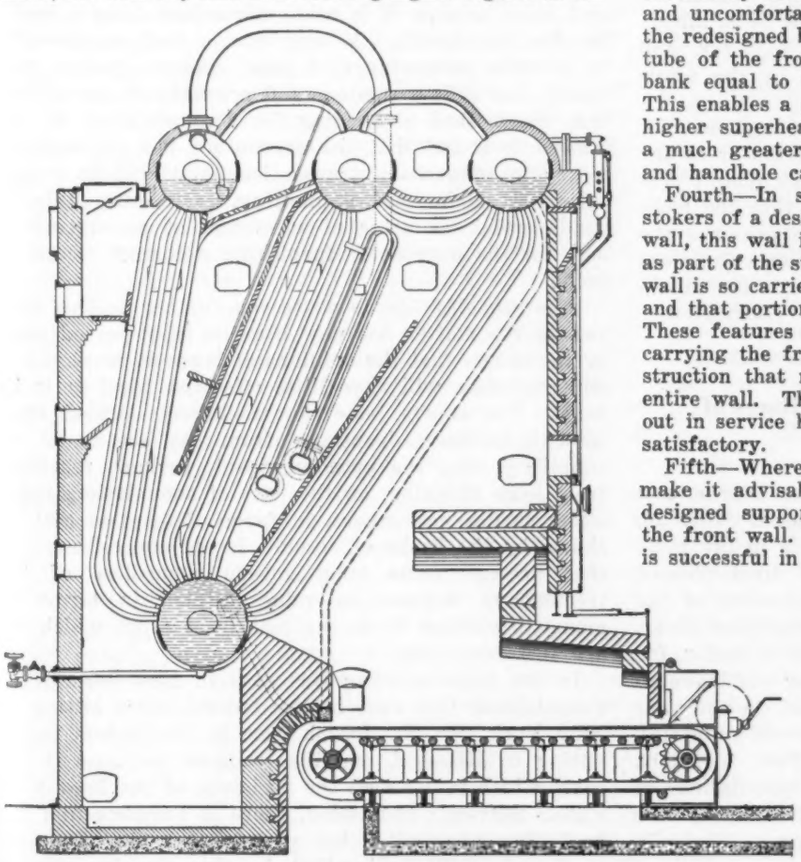
Third—The arrangement of the tubes circumferentially on the mud drum is such as to give a larger superheater chamber. In the earlier design the tubes were spaced equidistant around the mud drum, there being no space between the rear tube of the front bank and the front tube of the middle bank. This led to a superheater chamber excessively cramped at the lower end, making it difficult and uncomfortable to get at the superheater headers. In the redesigned boiler there is a space left between the rear tube of the front bank and the front tube of the middle bank equal to the space hitherto occupied by two tubes. This enables a greater amount of superheating surface for higher superheat than was hitherto obtainable and gives a much greater ease of access to the superheater headers and handhole caps.

Fourth—In stoker-fired work, except in the case of stokers of a design that permits of carrying the front boiler wall, this wall is carried on supporting members furnished as part of the standard boiler equipment. Where this front wall is so carried, a slip joint between the front boiler wall and that portion of the wall carried on the stoker is used. These features not only definitely fix the responsibility of carrying the front boiler wall, but give a front-wall construction that may be repaired without taking down the entire wall. The great number of such installations tried out in service have proved the construction to be entirely satisfactory.

Fifth—Where the size of the boiler wall is such as to make it advisable, the use of bonding tile with properly designed supporting members is standard construction in the front wall. This construction, as proved in operation, is successful in overcoming the tendency of the front wall to spring inward. This construction is used in side walls where necessary.

Sixth—In the earlier designs, where battery settings were installed, a three-legged center support was standard in the battery wall. In the redesigned boiler the center support has but two vertical members, doing away with this objection.

Seventh—In battery settings special means of access for inspection of the inside mud-drum heads is standard in the redesigned boiler. In the earlier designs no means of access at this point was supplied.



ONE OF THE NEW STIRLING CLASSES, WITH SUPERHEATER AND CHAIN GRATE STOKER

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Purpose of the Engineering Societies Building

To the Editor of the ELECTRICAL WORLD:

SIR: I am very much pleased with your editorial "The Illuminating Engineers Should Not Move," in your April 9 issue. I am not a member of the Illuminating Engineering Society, but I am a member of the A. I. E. E., the S. E. D., the N. E. L. A. and the New York Electrical Society. I am constantly visiting the United Engineering Societies Building and am familiar with conditions there.

One of the organizations occupying space in that building is using it for the strictly commercial purpose of sending out circular advertising material. Those of us who contributed to the purchase of the land had in our minds what undoubtedly Mr. Carnegie had in his when he donated the money to put up the building, namely, the erection of a home for engineering societies to which all engineers might come; and this naturally carried with it the idea of restricting the character of the work done in the building. It certainly was never intended to be used as it is being used now as an advertising headquarters for the automobile industry, and any such proceeding should be resented by the whole body of American engineers.

As a member of a number of societies and associations now in the building and as a contributor to the fund for the purchase of the land it stands upon, I protest against this proceeding and believe that the technical press should take up the fight to preserve the character of the United Engineering Societies Building. It is very rapidly deteriorating, and some action should immediately be taken. EXECUTIVE.

New York City.

Supplying Direct Current to Slip Rings of Induction Motor

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the article of Messrs. Warner and Knowlton which appeared in your issue of Nov. 20, 1920, and to the discussion of that article in the issue of Jan. 22, 1921, page 204, I should be much pleased if you would permit me to draw the attention of the public to the fact that the feature of supplying direct current to the slip rings of an induction motor for the purpose of improving the power factor was invented by Ernst Danielsson of Västeras, Sweden, in the year 1900. The invention was patented in several countries, among others the United States, on Feb. 25, 1902, under No. 694,092. A large number of installations of this kind have been built since that time by the Allmänna Svenska Elektriska Aktiebolaget of Västeras, to which the patents were assigned.

Västeras, Sweden. BIEGER NORDFELDT.

"Broadcasting" News by Radio Telephone

To the Editor of the ELECTRICAL WORLD:

SIR: I was much pleased to read your editorial in the March 26 issue of the ELECTRICAL WORLD on "The Influence of the Radio Telephone." For a long time I have been preaching this gospel in season and out, that the broadcasting by radio telephone of good music, interspersed with important news items and an occasional layman's sermon, good practical talks to farmers and to young people in the rural districts and similar features, can be made a genuine, potent factor for contentment and advance to the people of the United States.

Our installation at the California Theater in San Francisco is the first radio-telephone station which is devoted solely to this class of work. The responses we are receiving from listeners-in all over the Pacific Coast and mountain districts are most gratifying, indicating that this service is being appreciated and is a successful beginning along the lines which you are advocating.

LEE DE FOREST,
President.

De Forest Radio Telephone & Telegraph Company,
New York City.

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: The writer has noticed a letter in your issue for Jan. 29, 1921, signed by C. Wellington Koiner, which refers to an editorial of Aug. 21, 1920. Apparently Mr. Koiner advocates the use of the original-cost basis because it is more convenient from a bookkeeping standpoint. As one having had considerable to do with accountancy, I must protest against this theory, for it is a fundamental principle of accounting that the method of keeping the accounts must fit the transactions and that the accountant has no business to try to influence a transaction so it will fit a prearranged method of accounting. Obviously this is fundamental, as after all a system of accounting is only for the purpose of furnishing a correct record of facts.

It is probably idle to write you further on this subject as the matter has now been so fully passed upon by the courts that the opinions of lawyers, accountants and engineers will have little effect on what is to be done. The courts have now definitely decided that, notwithstanding advantages from the standpoint of simplicity, etc., the pronouncement, perhaps resulting from loose thinking, on the part of commission, regulatory bodies and others, in favor of original cost as shown by the books of account is not controlling, and that present value must govern regardless of the tremendous increase in values, stated in terms of money, resulting from the cataclysm from which we are just emerging.

In the Elizabethtown Gas case in New Jersey, the Consolidated Gas case in the federal court sitting in New York, the St. Joseph case in the federal court sitting in Missouri, and the Iroquois Gas case in the court which reviews all the decisions of the New York Public Service Commission, there is complete and unhesitating unanimity that what the courts have said continually still holds, that is, that the investor in property devoted to the public service is entitled to have

a fair return on the value thereof, such value to be determined at the time of the fixation of rates. Regardless of court decisions, however, this view is economically correct. No one can read the decision of Judge Learned Hand in the Consolidated Gas case recently decided, or in fact any of the other decisions just mentioned, without agreeing that this is so. Some time ago you urged editorially that self-interest, from the standpoint of the utilities, made it more desirable in the long run that returns should be computed on original cost, because if companies spent money today at the present high cost, when these costs went down they would suffer. This is not the case when the utilities are regarded as a whole.

If a company invests $100,000 today and the public service commission allows a 10 per cent return, the rate will be so fixed that $10,000 will accrue to the company for its investors. If prices return to what they were in pre-war times within the next ten years—which no one knows anything about—of course that property would be valued at $50,000, and, assuming for simplicity the same rate of return, only $5,000 would accrue to the company. Your editorial says that this demonstrates that the utility will lose $5,000 owing to the use of the present-value rule. Not at all, for the $5,000 which the utility receives at the future date will have as much purchasing power then as the $10,000 does now; otherwise the hypothesis of a reduction in the value from $100,000 to $50,000 is unsound. H. C. HOPSON,

New York City. Consulting Engineer.

Since dictating the foregoing, my attention has been called to a very interesting letter by C. M. Larsen, which appeared in your March 12 issue. While I have a very high respect for Mr. Larsen's opinions, particularly in view of his long and varied experience in dealing with these matters, I am compelled to say that I think he begs the entire question when he says that utilities ask for a value of $200 on property that cost $100 simply because it costs more to operate or because interest rates are higher. This is not at all the basis for the claim of increased value. The basis for the claim of increased value results entirely from the fact that whatever rate of return is used per $100, whether it be 8, 9 or 10 per cent, the dollars represent return, when received, for only one-half the purchasing power which they had before the war; whereas in virtually all lines of endeavor, particularly the lower grades of labor, the value of compensation is reckoned in a manner to give due account to this decreased purchasing power, or, in other words, the payments made are doubled.

Obviously it cannot be otherwise if index numbers are representative and have actually doubled as they are and have. The added quantity of return which should be received by reason of the decreased purchasing power has nothing to do, according to my understanding, with the increased cost of money as money measured by current interest rates. The forces affecting each may be somewhat the same and may work on each other, but when a man sells a piece of property for double what it cost him—though from a utilitarian standpoint it is worth no more—he not only receives the doubled price but, having received such doubled price, when he invests it, perhaps in real estate, he is not willing to take the 5 or 6 per cent which would formerly have been satisfactory, but insists upon the now prevailing rate of interest for such investment of 7, 8 or 9 per cent.

Those contending for the position which is taken by Messrs. Koiner and Larsen are, unintentionally of course, confusing the fair-minded utility people by arguing that the increased cost of money represented by increased rates of interest and the halved purchasing power measured by the change in index numbers are one and the same thing, and that they ought to be satisfied if they get the grudgingly scant consideration of the former, which is being currently given by many commissions—many up to date have refused to recognize either except in figures, confining themselves to the possibility of so doing in some future case—and that it is morally questionable, if not actually dishonest, to contend for the latter. H. C. HOPSON,

New York City. Consulting Engineer.

Wanted, a Better Name than "Fixture"

To the Editor of the ELECTRICAL WORLD:

SIR: The advent of the removable lighting unit calls for a new name, one which will more appropriately describe it than the often-abused term "fixture," by which ceiling and wall lights have heretofore been known. A fixture as defined by Webster is something fastened in place or, in law, an article affixed to the freehold and consequently confined to one place. No qualification of this word "fixture" can make it serve as an appropriate term to apply to the new lighting units, for its use would signify permanency.

The Society for Electrical Development feels that the new name—and a new one will surely be forthcoming—should be discovered or invented by one in the electrical industry and so invites the interest and co-operation of all in the search.

"Chandelier" will immediately suggest itself. This is a word derived from the noun "chandler," signifying a dealer in candles, oil, soap, paint and groceries, and was used to designate the first lighting unit of which there is any mention, the seven-branch lumière of antiquity. Early French historians classified chandeliers as chandeliers mobiles (movable units), chandeliers suspendus (hanging units) and chandeliers fixes (fixtures).

Reference is also made to the fact that the princes and "gentlefolk" had to have lumières that they could transport from their chateaus to the city or from the city to the country. The need introduced small metal lamps fashioned so they could be carried from place to place. Chandeliers suspendus developed into lumières and lustres, candelabra and girandoles. The wall bracket of today evolved from "appliqués." Lanternes, portatives or vivantes, became in time our modern lanterns.

These few references to lighting units of old have suggested "lumières mobiles" and "mobiliers" as appropriate names for the new units. Other suggestions have been "portaliers," "removaliers," "luminiers," "chatteliers," "chattelites," "plextures" and "elexiliers."

Slogans have been submitted as well, among which are: "Hang your light where it's right," "Move your lights to suit your moods," "Light right with right light," "Hang your lights—don't fix them." It is hoped that further suggestions will be forthcoming.

REGINALD TRAUTSCHOLD.

Society for Electrical Development, Inc.,

New York City.

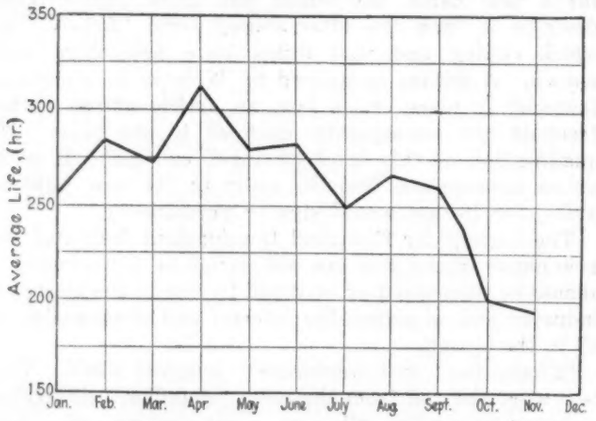
Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Quality of Electrodes for Arc Lamps Checked by Monthly Curves

FOR the purpose of keeping track of the life of electrodes used on the arc-light circuits of the Worcester (Mass.) Electric Light Company, the distribution department plots a curve from the monthly record, as shown in the accompanying drawing. This curve shows the average number of hours' life of all electrodes used in the street lamps.

Any falling off in the curve, such as that shown here in the last three months, leads to an investigation of



AVERAGE BURNING HOURS OF ARC-LAMP CARBONS SHOWN BY THIS CURVE

the cause of the decreased life. Curves of this nature have proved very useful to this department for other purposes. Descriptions of two of them were published in the ELECTRICAL WORLD for April 9 and 16. George M. Hardy, superintendent of the company, developed the curves and furnished them to the ELECTRICAL WORLD for reproduction. FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

A Ready Dressing for Serious Burns

AN EFFECTIVE solution for dressing large burns has been developed recently by H. B. Harmer, safety engineer of the Philadelphia Electric Company. This consists of a saturated solution of bicarbonate of soda in the best Russian mineral oil. About 3 per cent is taken up at ordinary temperatures, but in order to maintain such saturation an excess is put in and settles at the bottom of the container. A slight color is added for the psychological effect by a trace of one of the non-corrosive aniline dyes. This may be red, pink or green.

Large pieces of gauze bandage are rolled up and immersed in this liquid and are provided with a little knot at the ends, so as to make their extraction easy. These are one yard long and two yards wide and so will cover the entire affected part of a large burn. The dressing is contained in a two-quart glass jar with a "fruit-jar" cover made so that it can be completely opened in a moment. The solution does not deteriorate or become rancid and can be kept indefinitely.

The directions for use are as follows: "Remove gauze intact and cover burned surface thoroughly. Do not leave jar uncovered. This is to be used where large surfaces are affected, and the jar should not be tampered with. The tabs on the end of the gauze are the only part of it that should be touched while removing it from the jar. For refilling, notify the office of the supervisor of safety."

Instruments and Records for Boiler and Engine Rooms

FOR economical operation of a generating plant the proper instruments and records are imperative. Among the most important instruments are the draft gage, connected so as to read furnace, ash-pit and uptake pressures and the drop through the boiler; the pyrometer, to read flue-gas temperature, one instrument being connected to serve a number of boilers; the CO_2 recorder, or, where expense prevents its use, an "Orsat," and a thermometer in the feed line. Some method of determining the weight of coal and ash is essential, and a steam-flow meter is also desirable. By the use of the indicator varying conditions in engine operation can be detected and corrections made. The vacuum gage, preferably a mercury column, and thermometer for indicating the inlet and discharge temperature of the condenser circulating water are of great assistance in the efficient operation of the condenser and its auxiliaries.

Instruments for boiler and engine rooms which give a comprehensive view of operation have been sadly neglected till quite recently, and even now a large amout of steam is generated with the aid of no other instruments than a steam gage and gage glass. The instruments which tend to give a strong grasp on varying conditions are really signposts on the road to economy, and when they are properly used the investment is very well worth while.

Only such records should be kept as will be really useful. There is a tendency among some operators to require the power-plant employees to keep a lot of records, most of which are filed away and never consulted afterward. The writer favors a graphical form of record wherever it is possible to use such form, because it presents to the eye of the employee much better than a column of figures any change that may take place. It is of primary importance that accurate records should be kept of output and fuel. A continuous record of fuel burned, water evaporated and output is of far greater value in showing production cost and conditicn of equipment than any spasmodic tests of apparatus, no matter how thorough the latter. Important boiler-room records show quantity and temperature of feed water, boiler

pressure, draft and temperature of gases leaving boiler, time of cutting in and cutting out boiler, and when and how long boilers were "blown down." Important engine-room records give the load carried, vacuum, temperature of circulating water entering and leaving condenser, and hot-well temperature. Time of starting and stopping units should also be recorded.

C. A. GREENIDGE,
Chief Engineer.

J. G. White Management Corporation,
New York City.

Small Turbines Versus Electric Motors for Power-Plant Auxiliaries

AS FAR as efficiency goes, there is very little choice between driving power-plant auxiliaries by small turbines and driving them by electric motors. The electric drive requires less steam per horsepower-hour, but when the exhaust steam from the auxiliary turbine is used in the feed-water heater, then the actual quantity of heat used may be slightly in favor of the turbine.

To find exactly what choice to make the investment must be taken into account and worked out for each case. Although, generally speaking, there is not much difference in economy, there are other points in favor of electrical drive. For driving pumps motors are ideal, as hardly any attention is required and as on alternating-current circuits the speed is nearly constant, leaving no chance for a machine to run away on varying loads. The governing of small turbines on varying loads is often not perfect. For starting up with no electrical power available steam-driven auxiliaries are essential. It is sometimes advantageous to make some of the auxiliaries steam-driven and some electrical. In this way the heat balance of the station can be adjusted to give the most economical conditions.

Generally speaking, turbine-driven auxiliaries are smaller, owing to their higher speed. Turbine speeds are around 2,500 r.p.m. or higher, but the motor speeds most in use are 1,800 and 1,200 r.p.m. A two-pole, 60-cycle motor will run at 3,600 r.p.m., but pumps do not seem to be developed at this time for so high a speed.

It is sometimes thought difficult to determine just how much steam is taken by small auxiliary turbines. The following simple method is based on the fact that when they are supplied with superheated steam (this is virtually always the case at the present day) the exhaust steam is also highly superheated. It remains only to obtain the steam pressures and temperatures at the turbine throttle and exhaust, refer to steam tables, and from them to find out how much heat the steam contained before and after passing through the turbine. The difference in total heat represents the heat turned into work in the turbine and that lost by radiation, the latter being so small that it may be neglected altogether or an allowance of 1 per cent made. The difference in heat content, as found from the steam tables divided into the 2,545 B.t.u. in a horsepower-hour, gives the weight of steam per brake-horsepower-hour. The pressures and temperatures should be taken as near the turbine as possible to prevent excessive radiation losses. If really accurate results are required, the turbine should be lagged.

A. B. CLARK,
Engineer.

Sargent & Lundy,
Chicago, Ill.

Card Records for Distribution Poles

ALL INFORMATION usually required regarding the poles used in distribution systems may be kept on 4-in. x 6-in. cards. These should be filed by pole numbers or according to the numbers of houses nearest to the poles. A card of this kind which has proved valuable is reproduced herewith. The information includes the location, the year of setting, the kind of crossarms and fittings and the other equipment the pole supports.

It will be noted that consideration has been given to the matter of taxation, as experience has shown that without these data several different taxes may be paid on the same property. If it is known exactly where the property begins and ends for each of the city, county, township and school districts, this information will be valuable in connection with the assessment and payment

POLE RECORD

Street No. (a)____ Pole No. (b)____
City____ Co. ____ Twp. ____ Sch. Dist.____
Yr. Pole Set ____ Removed ____ Replaced ____
Location Street Alley Private — Pole Treated — Brush Butt Untreated — Cross Arm Dipped Painted Untreated
Kind of Wood____ Grade ____ Height ____
Cross Arm Fir Pine — 8 Pin ____ 6 Pin ____ 4 Pin ____ Pin ____
Insulators Glass Porcelain — Pins Wood Steel — Braces Flat Angle

Co. Pole	Lgt. Arresters	Painted
Joint Pole	Street Lgt.	No. of Services
Foreign Att.	Stepped	U. G. Services
Transformers	Guyed	Section Sws.

Ft. from Pole North East — To Pole South West

Remarks:

Date Pole Inspected ____ By ____

FRONT — FACING ____ — SIDE — FACING

Primary P ____ Street Lighting L ____
Secondary S ____ Direct Current D ____
Attachments T

Note:—(a) When pole is located in Alley or on Private property give address of the Street East or North of pole.
(b) Where poles are now being numbered you may insert number here, however, this is optional.
Any special material should be noted under "Remarks."

ALL NECESSARY INFORMATION CONCERNING A DISTRIBUTION POLE IS CONTAINED ON THIS 4-IN. X 6-IN. CARD

of taxes. The records are useful for obtaining information pertaining to the life of different poles under certain climatic conditions and also concerning what effect the different methods of treatment have upon the life of the pole.

Considerable discussion has always been raised as to the desirability of numbering poles consecutively. While the writer favors this method in properties of the larger size, some dividing line should be adopted as to towns large enough to justify its application. The writer believes that poles in cities of about 100,000 inhabitants or larger should be numbered in some systematic order.

Where poles are not numbered an excellent plan is to file the cards geographically; that is, the pole record card would bear the address of the house nearest it. A pole in an alley can be designated by the geographical location of the house on either the north or the east side of the alley, or the address in the street on the south or west side of the alley. By this plan there is no con-

fusion where there are pole lines in the alleys on both sides of a given street.

THEODORE H. RICE,
Operating Department.
Henry L. Doherty & Company,
New York, N. Y.

Rules to Be Followed While Working Around Boilers and Stokers

TO SAFEGUARD men working on stokers and boilers the Consumers' Power Company has formulated a set of rules the substance of which is given in the following paragraphs:

Chain guards on Taylor stokers should be kept in position at all times. When working on the driving parts of these stokers the chain should be removed to guard against accidental starting of the stoker. When dumping Taylor hand-dump stokers care should be exercised to insert the dumping bar in the socket far enough to prevent it from slipping out. Many employees have received serious injuries through lack of this precaution. The dump pans on Taylor stokers should be lowered while repairing stokers and bridge walls. Repairmen should stand on planks instead of on the dump pans, for these might accidentally be lowered, dropping the repairman into the ash alley. Always shut off the forced-draft supply when cleaning Taylor stokers. If it is left on, it is apt to blow fire through the cleaning door and burn the fireman. Fire doors must be latched at all times. There may be a defective tube in the boiler, and if it should rupture, fire would blow out through the doors not latched. A number of serious accidents have occurred through neglect of this simple precaution.

Water columns should be blown down when the fireman comes on duty. This should be done without fail at the beginning of each shift. Chains attached to quick-closing valves on water glasses should be of such a length and hung so as not to interfere with or be an attractive hazard to passers-by. When wetting down hot ashes firemen should stand back to avoid being burned by the steam generated from them. Goggles should be worn when working around gage glasses. These glasses may break, and every possible precaution for protection should be taken. Men should not step or stand on the Dutch-Oven furnace of Wickes boilers. The failure of the brickwork might cause them to fall into the furnace.

Before men are allowed to go into a boiler the head fireman and water-tender must be notified and feed valves, steam valves and blow-off valves must be marked with the special tags provided. When blowing flues the ladder should be held by another man or otherwise secured, and when using live steam men should be very careful not to burn themselves or others. When necessary to work on coal hoppers be careful to keep clear from weighing lorry. Men have had their fingers crushed by neglecting this. Sufficient illumination should be provided in firing alleys, basements and on top of boilers. Men are liable to stumble over firing tools or miss their step when on the boilers, causing serious falls.

When removing ashes through a jet system ashmen must see that the line is open. If it is plugged up, steam will blow back and burn them. Turn on steam slowly and be sure line is clear. When throwing in or out driving pawls on Greene stokers to change the speed the operator must be careful not to get his fingers crushed in the mechanism. Counterweights on dampers should be permanently attached or hung close to the floor, to prevent them from falling and injuring any one who may be standing or passing under them. When removing tubes from boilers, if necessary to open the top boiler covering, this material should be piled so it cannot fall on men workng below.

Scuffling, horseplay and practical jokes are prohibited. Men have been seriously injured by being thrown into moving machinery. Boilers require constant attention. Employees must be on the lookout for unusual conditions and must maintain the water level and steam pressure within normal limits at all times.

Consumers' Power Company, H. J. BURTON.
Jackson, Mich.

Improved Testing of Reverse Power Relays

OWING TO incorrect operation of some reverse-power (directional) relays on the system of the Utah Power & Light Company a new method of testing the connections has been worked out and put into practice. Since this relay is fundamentally an induction-type wattmeter, tending to rotate in one direction or the other according to the power flow, its torque is a measure of the power in the circuit. Hence if the movement of the disk is opposed by a spring, the deflections of the disk under various conditions will determine the proper connections. Such a spring is readily provided, after the tripping circuit has been opened for safety, by inserting a small peg back of the spring contact to shorten its length and thus to increase its stiffness so that the contacts do not quite close under the maximum torque produced by the load flowing during the test. A small pointer of tin is slipped under the data plate to register on the edge of the disk, on which are scratched a mark for zero when the potentials are off and graduations up to full deflection.

The necessary switching is then done to obtain a known condition of power flow of a dependable value. In many cases it is possible to vary the power factor of the line to give check results, though this is not essential, since an inductive load is the usual case or can be arranged for. The voltage leads are then marked *A*, *B* and *C* respectively and are arranged to be applied in consecutive pairs to the potential studs of each relay in turn. If the power factor can be made unity, deflections are first taken under a certain chosen load with each voltage pair in turn on the first relay. If the instrument transformers are installed as required to give star current and delta voltage, there will be found two pairs, say *AB* and *AC*, which give about the same deflection, each voltage being about 30 deg. out of phase with the current, while *BC* give virtually zero, since it is in quadrature. This eliminates *BC* from consideration with this relay. The selection between *AB* and *AC* is then made by having the power factor lagging in the line, when one of these voltages will give a higher and the other a lower deflection than under the previous test. Obviously the one that gives the higher torque for the same load under the lagging power-factor condition is the one that will give the most dependable action under the short-circuit conditions.

A. N. GEYER.
Utah Power & Light Company,
Salt Lake City, Utah.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Portable Rack for Supporting Outdoor Motor Circuits

FOR supporting circuits which supply energy to electric blast-hole drills the France Stone Company, North Baltimore, Ohio, developed a portable rack made of iron pipe. This rack should be useful for other applications where temporary or movable lines are used for drills, motors and similar apparatus. The racks are about 6 ft. high and in the work mentioned are placed about 50 ft. to 75 ft. apart. They keep the wires dry and prevent current leakage and short circuits. Ballast plates are provided on which weights may be laid to prevent the racks from being blown over. In using for blast-hole drills a complete circle line is carried on the racks unless the quarry is too large. Such a circle assures better voltage at any point. No. 6 stranded weatherproof wire is used for 440-volt work unless the line is exceptionally long or there is a large number of drills operating.

PORTABLE STAND FOR CARRYING MOVABLE ELECTRIC CIRCUITS

About 100 ft. of No. 8 three-conductor Duracord is employed (with three-phase, 440-volt current) for a cable to reach from the drill to the portable line. Hubbell weatherproof attachment plugs are connected every 75 ft. along the portable line for attaching the cable.

A 1½-in. swinging pipe is mounted in the top of the drill cab for supporting the cable in such a way that the wheels of the drill will not run over it. This pipe should be composed of a vertical section strapped in the cab, an elbow at top of the vertical section and free to swing horizontally, a horizontal section about 10 ft. long with a 45-deg. bend downward at the outer end. About 4 ft. out from the elbow this horizontal section should have a support on which the pipe can rest and slide from side to side. The open ends of the vertical and horizontal sections should be fitted with 1½-in. conduit bushings. The cable should be fed through this pipe and taped quite heavily at the open ends of the pipe. This prevents injury to the cable at those points. At the bottom end of the vertical pipe an ordinary cable clamp should be clamped on the cable over its heavily taped portion. This will prevent the cable from being pulled out of the pipe.

A General Electric type FP10 oil circuit breaker is used on the drills instead of knife switch and fuses. This not only provides a totally inclosed safety switch but avoids the fuse trouble that is always had where fuses are used on blast-hole drills. The vibration of the machine causes the fuses to jar loose in the clips, causing the fuses to become hot and fuse ferrules and clips to become pitted. The circuit breaker should have overload coils so as to protect the motor against overload. This type of breaker should also be used to control the power for the entire line.

D. W. YAMBERT,
Electrical Engineer.
France Stone Company,
Toledo, Ohio.

How Often Should Lighting Fixtures Be Cleaned?

THE necessary frequency of cleaning lighting fixtures may be determined by balancing the loss from decreased illumination against the cost of cleaning. The loss from decreased illumination is divisible into the loss of electrical energy which is caused by the dirt and the decrease in output of workmen due to poorer light. These losses increase daily after each cleaning. When the sum of these losses since a cleaning equals the cost of one cleaning the fixtures should be cleaned again.

By far the most difficult of these factors to determine is the loss in output of workmen due to poorer light. This must include spoilage and overhead cost of plant as well as possible labor turnover due to dissatisfaction and loss from future deteriorated eyesight. The energy loss can easily be calculated by the aid of a foot-candle meter or a photometer.

The cost of cleaning may be determined by trial. Lighting fixtures may be dusted, wiped or washed. The method used should be the one which will produce the most economical results. Sometimes a combination of methods may be employed to advantage. For instance, the fixtures may be washed every two months and dusted every two weeks between washings. The type of fixture, character of dirt, etc., determine to some extent how the cleaning should be done. The length of time required is another important determining factor. Usually it takes more time for a man to get down from one fixture and up to the next than it does to clean the fixture. When this is the case fixtures should be cleaned as thoroughly as possible.

The usual length of time between cleanings is from three to six weeks, but the right time for cleaning should be separately determined for each case. Among the factors which affect frequency of cleaning are the illumination provided by clean equipment, illumination required, kind of fixture, amount and kind of dust in the air and the season of the year. Indirect and semi-indirect fixtures are very liable to collect dust and dirt which cannot be seen but which, of course, continues to cut down the useful illumination as time passes. Although reflectors for direct lighting can be seen, it is hard to judge from their appearance how much light is being absorbed by the coating of dirt. Consequently an instrument should be used to measure the illumina-

tion. Just as the fireman's judgment as to the management of his steam plant is now assisted by instruments in addition to visual inspection of the fires and boilers, so must the judgment of the men in charge of illumination be assisted by a suitable light-measuring instrument.

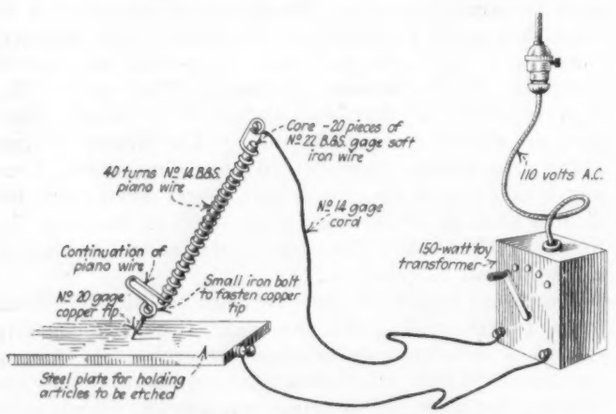
D. W. BLAKESLEE.

Pittsburgh, Pa.

Inexpensive Electric Etching Pencil

A PRACTICAL and inexpensive etching pencil illustrated herewith is made for use in marking tools, dies, instruments or other metal objects. It is simple in construction and any one handy with tools should be able to make one out of materials found in most machine shops. The construction of the pencil is as follows: A coil spring of No. 14 gage wire is made of about forty turns. Into this spring a soft-iron core is inserted, consisting of about twenty pieces of No. 22 gage soft-iron wire. The soft-iron wire core should be insulated from the coil by a few turns of paper of good quality. One turn of the spring coil should be turned up, to which one terminal of the transformer is to be connected (see upper part of pencil in illustration). The lower end of the spring should be shaped in a "U" and the tip looped as shown. A small iron screw and nut are used for fastening a piece of fine copper wire which serves as the etching needle. Cover the entire pencil with a few layers of paper, dip in insulating varnish and allow to dry thoroughly.

In operation the iron screw and nut holding the short piece of copper wire vibrate, which makes a series of small dots. After a little practice it will be found that very fine work can be done if the operator has a steady hand and is a good letterer. The function of the spring coil is to act as a resistor and as a magnetic coil for vibrating the copper tip. Do not attempt to use a heavy copper tip for etching, as this will take more current and heat up the entire pencil. Energy is furnished by a 150-watt toy transformer or a storage battery. In either case from 4 volts to 10


Core - 20 pieces of No. 22 B&S gage soft iron wire
40 turns No. 14 B&S piano wire
No. 14 gage cord
110 volts A.C.
Continuation of piano wire
150-watt toy transformer
Small iron bolt to fasten copper tip
No. 20 gage copper tip
Steel plate for holding articles to be etched

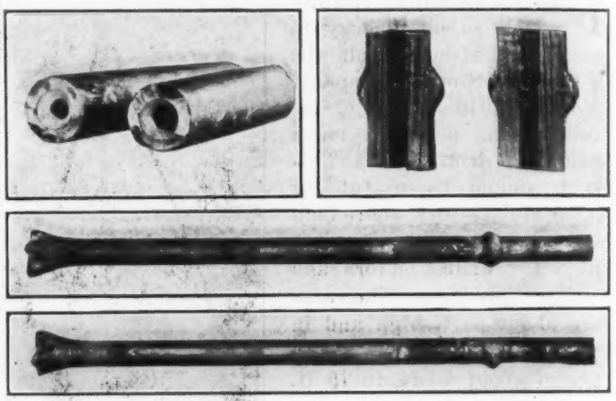
PENCIL FOR ELECTRIC ETCHING OF TOOLS, DIES, ETC.

volts may be used, depending on the kind of etching desired. The pencil will have a tendency to become warm after continuous use and should be allowed to cool when it becomes too hot to be held comfortably in the hand.

JOHN A. TOLEIK,
American Can Company, Electrical Engineer.
Chicago, Ill.

Rock Drill Steels Too Short for Use Reclaimed by Welding

EXPERIMENTAL tests which have been carried out by the Thompson Company to determine the practicability of reclaiming short lengths of rock-drill steels have shown that electric butt welding is a feasible process for this work. Steels welded in this manner have given very satisfactory results when tested under conditions somewhat more severe than normal. The drills used in these experiments were hollow drills 1¼-in. in diameter containing 95 per cent to 1.05 per cent carbon. A hollow instead of a solid drill was chosen as



DRILL STEELS ELECTRICALLY WELDED HAVE SHOWN EXCELLENT RESULTS IN TESTS

Top, left—In preparing the broken steels the ends are squared off and countersunk. Top, right—A lengthwise section showing that the water hole area is not greatly reduced by welding. Center—The weld as it appears when removed from the welding machine. Lower—The upset may be removed by grinding.

presenting a more difficult type to weld, owing to the fact that the water hole must be kept open.

In welding such steels the ends to be joined should first be ground off fairly square and the greater part of the rust, scale, etc., removed for 3 in. or 4 in. back in order to insure good electrical contact with the dies of the welder. Then these two ends should be countersunk with an 80-deg. countersink to a depth of approximately ¼ in. This countersinking prevents the "flash" and metal which is pushed up during completion of weld from filling up or clogging the water hole.

The steels are then clamped in the copper dies of the welder, these dies, which conform to the shape of the drill, being in reality the terminals of the secondary of a simple current transformer, which takes any commercial power voltage on the primary side and steps it down to very low voltage in the secondary, while increasing secondary current over primary current in approximately the same ratio. The steels are clamped so as to give a length projecting from the inside edge of each pair of dies which is equivalent to from one-half to three-quarters the diameter of the drill. The drills should also be brought into accurate alignment by means of simple adjustments.

The weld is made by what is known as the part-flash, part-slow-butt method, the first step being to bring the ends into close proximity by means of a pressure device integral with the welder and then to close the primary circuit of the transformer, continuing to bring the steels together slowly until their ends actually touch each other lightly, whereupon they will "flash," that is, minute particles of molten steel will fly off. This flashing should be continued by keeping the circuit closed and

slowly forcing the ends of the steels together until the ends are "flashed" off square and are in even contact around their entire periphery. Usually, if the ends are properly prepared, a forward movement of about ⅛ in. of right-hand steel is sufficient to accomplish this. Do not "flash" too much or the water hole will become clogged.

At the end of this flashing movement a quick further forward movement will bring the ends of steels into good solid contact and stop the flashing. Now, with the circuit still closed but with little or no added pressure on steels, allow the joint to reach the welding temperature which is indicated when the metal at and around that point has a "greasy" appearance or seems on the verge of running and sparkling, when instantaneous and heavy pressure should be applied and the steels forced together, completing the weld and at the same time opening the primary circuit. Great care should be used not to overheat the steels, as not only will the structure of the steel at the joint be damaged beyond repair, but the water hole will become clogged owing to too great a "push-up" in completing the weld. Too little heat will result in only a "stick," not a weld.

A flux of plain powdered borax is sometimes used and is applied by merely sprinkling it on the joint with the fingers at the end of the flashing operation. This flux has been found to be of aid in preventing the oxidizing of the joint, and while its use is not absolutely necessary, it is recommended.

The matter of removing or leaving the "upset" at the weld is one for the user to decide. The greater the amount of this upset that can be retained, the stronger the bar at that point and the less the labor of reclamation. However, on steels where this upset has been almost entirely removed the steels in actual working tests have broken at any point except in the welded area.

The time consumed in preparing the ends to be welded is very little. For example, in the case of the 1¼-in. hollow steels it should be approximately as follows: Grinding ends square and removing scale, two minutes; countersinking, one minute. The average welding time on the above size is fifteen to twenty seconds and the power consumption is not over 0.25 kw.-hr. per weld. The open-circuit secondary voltage should be approximately 4 volts to 4.25 volts to insure ease in flashing. One man should be able to prepare and weld complete two pieces of drills of the above size in five minutes.

Every weld should be properly heat-treated to relieve any locked-in stresses and to refine the grain structure. This can be done in the welder by increasing the opening between dies to 3 in. or 4 in., again clamping the welded steel in the dies, heating to the proper temperature and forcing the metal to cool slowly by placing it in lime or a similar slow-cooling medium. This method of heat-treating, while fairly satisfactory, does not, of course, have the same merits as a furnace-heat treatment, and where a furnace is available the latter method is recommended.

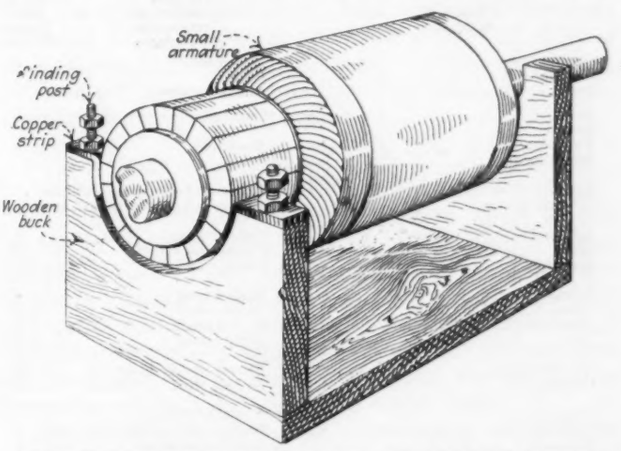
Tests on steels welded by this method were carried out by the Sullivan Machinery Company at its experimental quarry in Claremont, N. H. The drilling machine used was a Sullivan DX-61 type, which takes air at 100-lb. line pressure and strikes a blow of 100 ft.-lb. on the ends of steel at the rate of 1,400 blows per minute, the drill being continuously rotated at the rate of approximately 150 r.p.m. in free drilling. The rock drilled was what is known as blue schist, which, though not so hard as some rocks, does, perhaps, owing to its seamy structure, place fully as great a strain on the drill as the harder rocks. In all tests the steels were run unsupported. To explain: It is understood by the writer to be the general practice to feed steels used in "drifting" to the machine in lengths varying in steps of 2 ft.; that is, the first drill is a so-called 2-ft. length, the next 4 ft., and so on, so that at no time is there more than approximately 2 ft. of distance between the rock being drilled and the chuck of the drilling machine; but in all of these tests each steel started its own hole, so that there was at the start of the drilling of each hole a distance of 8 ft. to 10 ft. between the rock and the drilling machine. Each hole was about 2 ft. in depth and was drilled in approximately a horizontal plane with the steels oftentimes more or less out of line.

Six of the steels welded as described above were tested in this manner, and all except one broke at a distance anywhere from 4 in. to 3 ft. from the weld after drilling totals of from 5 ft. to 146 ft. The remaining one, which broke in the weld, had drilled 121 ft. These steels before being welded by the above method had drilled totals varying from 26 ft. to 140 ft. To sum up, the only steel which failed in the weld drilled a distance fully as great as the average total of the other five steels, all of which broke outside of the weld.

Thompson Electric Welding Co. W. T. OBER,
Lynn, Mass. Development Engineer.

Support for Bar-to-Bar Test on Small Armatures

WITH small motors it is often difficult to apply a bar-to-bar test for damaged coils and reversed leads. For making such a test easy in a certain shop a small buck, just the size for the armature to be tested, was made with one upright cut out to fit the commutator instead of the shaft. This upright was fitted with two strips of copper, as shown in the accompanying drawing, so that when the armature was placed in the buck the commutator made contact with these



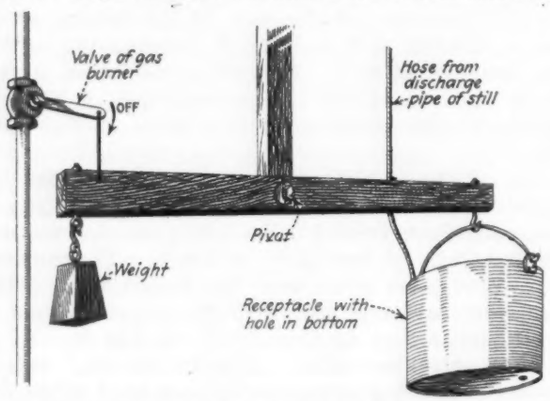
CONNECTIONS FOR BAR-TO-BAR TEST ARE MADE BY COPPER STRIPS AT SIDES OF COMMUTATORS

strips at two points directly opposite each other. The direct-current feed lines were attached to these strips by means of the binding screws. The bar-to-bar test is made by turning the armature in the buck and touching adjacent bars at the top point of the armature with the leads from a small millivoltmeter. FRANK SOETE.

Honesdale, Pa.

Preventing Burn-Out of Still Used for Storage-Battery Water

TO PREVENT the burn-out of a still used in purifying water for batteries the fire must be extinguished when the cooling-water supply fails. An automatic method for turning out the gas on failure of the water prevents such burn-outs in the vehicle battery department of the New York Edison Company. The scheme employed is indicated in the accompanying sketch. This shows a weight hung to an arm which is connected by a



WEIGHT CLOSES VALVE WHEN COOLING WATER STOPS FLOWING

wire to the valve on the gas burner. This weight tends to turn the valve to the "off" position.

The bar, which is about 4 ft. long, is pivoted in the middle, and to the other end is hung a small vessel into which the discharged cooling water flows. This vessel has a hole in the bottom through which the water runs. The hole, however, is of such a size that the vessel is always full while the water is discharging in the right quantity. The weight of this water counterbalances the iron weight on the other end of the beam. In case, however, the water ceases to flow from the discharge pipe the vessel becomes empty and the weight closes the valve of the burner.

Before the protective arrangement was used the coils of the still were overheated and badly damaged a number of times. Since its installation there has been no more such trouble.

A. SHEINAUS,
Fore Battery Man, Auto Department.
New York Edison Company,
New York, N. Y.

Properties of Resistor Materials Used for Heating Purposes

THE principal materials suitable for electric heating resistors are listed in the accompanying table together with their physical properties. There are eight classes of materials. The metals of the first group—copper, platinum, wrought iron, cast iron, tungsten and molybdenum—are used for resistors in special cases only and are not widely employed. The other groups show various specific resistances and maximum operating temperatures. The nickel-steel-chromium alloys (group 5) are suitable for electric resistors which are not subjected to temperatures higher than 1,200 deg. Fahr. The nickel-chromium alloys can be operated at temperatures as high as 1,800 deg. to 2,000 deg. Fahr. without being injuriously affected and their resistance is about sixty times that of copper. With the discovery of this group of alloys the foremost technical difficulties, which prevented the general use of electric heat, were removed. However, nickel-chromium is not suitable for all purposes under all conditions. On the contrary, electric heaters have to be carefully designed for each individual duty, and if this is not done, the possibility of "burning out" the heaters exists.

PROPERTIES OF HEATING-RESISTOR MATERIALS

Name of Substance	Physical Condition or Composition of Substance	Manufacturer or Agent (See Names Below)	Resistance in Ohms per Circ.mil Ft. at 68 Deg. Fahr.	Temperature Coefficient of Resistivity for 1 Deg. Fahr.	Specific Gravity, Grams per Cu.Cm.	Approx. Maximum Working Temp. in Open Air, Deg. Fahr.	Approx. Melting Point, Deg. Fahr.
Copper	Annealed	..	10.4	0.00217	8.89	500	1,981
Platinum	Pure	..	57.4	0.00204	21.50	2,700	3,190
Iron	Annealed wire	..	62.9	0.00280	7.78	750	2,700
Iron	Cast, gray	..	380.0	.....	7.21	1,000	2,700
Nickel	Annealed	..	64.3	0.00400	8.90	1,200	2,940
Tungsten	Annealed	..	136.2	0.00250	19.10	.....	5,432
Molybdenum	Annealed	..	34.3	0.00185	8.60	.....	4,532
German silver	18 per cent copper, nickel, zinc	..	200.0	0.000172	8.50	500	1,880
German silver	30 per cent copper, nickel, zinc	..	290.0	0.000111	8.50	500	2,120
Advance	Copper nickel	1	294.0	Nil	8.90	700	2,300
Ideal	Copper nickel	2	300.0	0.00001	8.85	700	2,200
Monel	Copper nickel	3	256.0	0.00198	8.90	1,112	2,480
Krupp	Nickel steel	4	511.0	0.00039	8.10	1,100	.....
Climax	Nickel steel	1	525.0	0.00040	8.14	1,000	2,300
Phenix	Nickel steel	2	520.0	0.00030	8.09	1,000	2,100
Tico	Nickel steel	5	517.0	.....	....	.....	.....
No. 193 Alloy	Nickel, steel, chromium	1	523.0	0.00040	8.15	1,200	.....
Comet	Nickel, steel, chromium	2	525.0	0.00040	8.15	1,200	2,750
Nichrome	Nickel chromium	1	660.0	0.000095	8.15	1,800	2,700
Nichrome II	Nickel chromium	1	660.0	0.000099	8.02	2 000	.....
Kromore	Nickel chromium	1	580.0	0.000134	8.90	2 100	.....
Calido	Nickel chromium	2	600.0	0.000190	8.15	1,800	2,800
Rayo	Nickel chromium	2	575.0	0.000100	8.05	2,000	3,000
Chromel "C"	Nickel chromium	6	640.0	0.000100	8.12	.....	.....
Carbon	Retort	..	4,325*	Not constant	1.80	6,000†	6,700
Graphite	Acheson	..	4,875*	Not constant	2.20	6,000†	6,700
Carbon filament	Treated	..	6,950‡	Not constant	....	3,500†	6,700
Granular carbon	Amorphus	..	.....	Not constant	....	6,000†	6,700
Silit	II	7	.....	Not constant	....	2,500	.....

* At 5,400 deg. Fahr. † Air excluded. ‡ At 3,500 deg. Fahr.

1. Driver Harris Company. 2. Electrical Alloy Company. 3. Supplee-Biddle Hardware Company. 4. Thomas Prosser & Son. 5. American Steel & Wire Company. 6. Hoskins Manufacturing Company. 7. Gebruder Siemens & Company.

While the development of the metallic resistor was going on, carbon, graphite and similar substances were also tried out, and it appears that during the last few years resistors made of these materials have been used with success. The principal substances of this class are listed in the last two groups. Naturally, when using carbon or graphite, it has to be realized that these materials oxidize very rapidly at comparatively low temperatures. This objection, however, is not so serious as it may appear at first glance, simply because whenever carbon or graphite is used it is either inclosed in such a manner that little air can get in contact with it, or in case the air should strike the resistor, carbon monoxide and carbon dioxide are formed rapidly, retarding the oxidation. Therefore renewals of these resistors need not be made as often as might be anticipated, and since carbon and graphite are low-priced materials, this upkeep is not more expensive for a careful design than the renewals of resistors of the metallic type. Silit, mentioned in the last group, is a substance which has not yet been used extensively in this country. In Germany and Switzerland, however, excellent results have been obtained.

H. O. SWOBODA,
Pittsburgh, Pa. Consulting Engineer.

Localized Blower Improves Working Conditions

FUMES from melted resin and beeswax which formerly annoyed workers at the Boston repair shop of the Western Electric Company, Inc., are now easily exhausted from the room by the ½-hp. motor-driven blower shown in the accompanying illustration. The blower, a Sturtevane "E-6" fan with 5-in. discharge duct, is directly connected to a 220-volt, single-phase motor running at 1,800 r.p.m. Over the rear of the

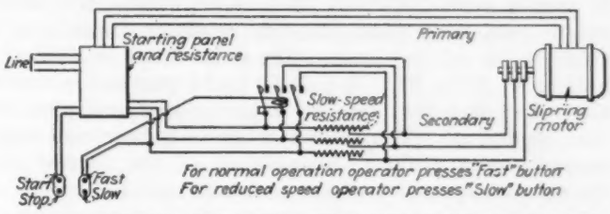
ALL FUMES FROM MATERIAL MELTED IN THIS POT ARE DRAWN OFF THROUGH THE METAL HOOD

melting pot, which is electrically heated, a 12-in. x 18-in. metal hood is placed to collect the fumes for subsequent discharge through a short duct leading outdoors. The draft thus induced had a tendency to lower the temperature of the pot. Therefore, to insure steady flowing of the melted material, which hardens almost instantly upon being exposed to the air, a supplementary electric heating coil was applied to the discharge pipe just back of the faucet.

J. S. THOMAS.
Western Electric Company, Inc.,
Boston, Mass.

Slow-Down Resistance for a Slip-Ring Motor

IT WAS FOUND desirable to slow down the speed of a continuous-duty slip-ring motor in an installation of shaking screens while handling coarser materials, returning again to normal speed for the finer material. This was accomplished by inserting in the rotor circuit a resistor which could be shunted in or out as



RESISTOR WHICH MAY BE INSERTED INTO SECONDARY LINES OF MOTOR IN ORDER TO SLOW DOWN SPEED

desired. The installation consisted of a 15-hp. slip-ring motor with remote control, having resistance designed for starting duty only. The fixed resistor for the low speed was therefore placed in the secondary leads near the motor, and a circuit with a switch in it was shunted around this resistor. This was a three-pole magnetic switch operated by push-button control at the same point as the starting control. The motor is started with the resistor cut into the secondary circuit, and when the faster speed is desired the button marked "Fast" is pushed and this shunts out the resistance.

The slow-down resistance must be of sufficient cross section to carry the secondary current continually and of such ohmic resistance as to cut the torque and therefore the speed (assuming the load be over 50 per cent of rated full load) to the desired point. If it is a three-phase machine the secondary current rating can be obtained from the motor manufacturer, or can be calculated closely enough from:

$$\text{Sec. amps} = \frac{HP \times 746}{\sqrt{3} \times \text{voltage between rings}}$$

The proper ohmic resistance is hard to figure closely as one seldom knows the exact load. The torque varies as the square of the voltage, and the speed in turn depends upon the torque and load. The practical method, having so many unknowns, is to provide a resistor of sufficient current-carrying capacity and try taps between different sections of the resistor until the machinery operates satisfactorily under the actual load.

The motor could have been slowed down by inserting resistors in only two of the three phases, but this would have drawn unbalanced currents from the line on low speed. In case the expense of an automatic switch is not warranted in such an installation, an ordinary knife-blade switch might be used instead of the magnetic type. If such an arrangement is desired on a new installation, it would be better policy to use the standard speed-control equipment furnished by manufacturers.

Chicago, Ill. H. T. N.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Employees and Customers Oversubscribe Million-Dollar Note Issue

EMPLOYEES and customers in the territory served by the company recently absorbed the entire offering of $1,000,000 of 8 per cent five-year gold notes of the Portland (Ore.) Railway, Light & Power Company in twelve days. Average daily sales during the campaign were more than $90,000, resulting in an oversubscription of the issue. The notes were in denominations of $100, $500 and $1,000, and purchasers were allowed to pay for them on a partial-payment plan if they so desired. The total number of subscribers was approximately 3,200. Commenting on the success of the sale, an executive of the company said:

"Loyalty to and confidence in the company were displayed by the employees, nearly 70 per cent of whom bought a total of almost $400,000 worth of the notes.

"Of the entire offering 90 per cent was disposed of in the immediate Portland district, the balance being scattered over the thirty-odd communities receiving light, power and transportation service from the company.

"One of the gratifying features of the campaign was the fact that nearly 70 per cent of the total sales were cash subscriptions and the wide distribution of the sales is shown by the fact that the largest individual order was for $7,500."

Company Courtesy Gains Customers' Appreciation

WHEN the Oklahoma Gas & Electric Company connects a new customer to its lines—one who has not been on the books of the company before—the following letter is sent to him:

"DEAR SIR: We are indeed gratified to have you become one of our customers, and I beg to take this, my first opportunity, to assure you that we sincerely appreciate the privilege you have given us of adding your name to our list of patrons.

"To serve you faithfully and well, with complete satisfaction in every detail, is a frank expression of the obligation we assume. Our organization and equipment are necessarily extensive to serve all the people, but we regard the individual customer as the most important consideration in our business.

"We would like you to feel that you are at all times a valued patron and that every department and individual in this company is constantly interested in seeing that you are properly, economically and courteously served. If you do not receive this attention, I shall deem it a favor to have you call the matter to my personal attention. J. F. OWENS, General Manager."

This is, of course, a form letter, designed to pave the way for friendly relations and good will between company and customers. That it is effective and that the public really appreciates this mark of courtesy is evident from the following letter recently received by the Oklahoma Gas & Electric Company from a new customer:

"I received your follow-up letter shortly after I had signed a contract for service in my residence, and while I know it is a form letter, it shows that the Oklahoma Gas & Electric Company is anxious to do all in its power to assist the customer and create a spirit of good will toward the company. It occurred to me that it was a pretty fine idea, in spite of the fact that your company has no competition in its field but seems to be going out of its way to do little things that tend to build up a spirit of co-operation and assistance between the customer and the company. It seems to me that the entire organization reflected this spirit in the small dealings I had in opening up a new account with your company."

A Practical Method of Rating Central Station Employees

BY J. E. SHUTE
Personnel Superintendent Penn Central Light & Power Company, Altoona, Pa.

ABOUT a year and a half ago the Penn Central Light & Power Company, operating in five counties in central Pennsylvania, with headquarters in Altoona, inaugurated a personnel department. In order to obtain the best system possible and to profit by the experience of others, we secured the services of Major Frank F. Hennaman, who had been engaged in this class of work in the United States Army. He prepared and submitted a tentative plan of rating employees one against the other in the same class of work, trade or duty.

Our management appreciated that the plan was more or less radical and that if it was to be successful it would have to be "sold" to the organization before it was put in operation. Every member of the company

EMPLOYEES' RATING SCALE

JOHN DOE, Lineman

1. Intelligence: Consider readiness of comprehension and ability to learn rapidly	Highest	*White*	15	
	High	*Brown*	12	Doe 12
	Middle	*Green*	10	
	Low	*Gray*	8	
	Lowest	*Black*	5	
2. Skill: Consider accuracy, speed, interest and adaptability	Highest	*Brown*	20	
	High	*White*	15	
	Middle	*Green*	12	Doe 12
	Low	*Gray*	9	
	Lowest	*Black*	6	
3. Initiative: Consider alertness, originality of conception and independent and prompt action particularly in a case of emergency, and the readiness to shoulder responsibility for actions	Highest	*Brown*	30	
	High	*White*	15	
	Middle	*Gray*	15	Doe 25
	Low	*Green*	10	
	Lowest	*Black*	5	
4. Personal Qualities: Consider obligation of duty to the company, spirit of co-operation, common sense, reputation, discipline, veracity and sense of right	Highest	*Green*	35	
	High	*White*	30	
	Middle	*Black*	25	Doe 25
	Low	*Brown*	20	
	Lowest	*Gray*	10	
Total rating			74	

in a position of authority was called in to a conference and the plan as submitted was placed before them for their criticisms and suggestions. After a number of conferences a system was finally agreed upon.

The plan as adopted, one which had the unanimous approval of the conference, was a man-to-man comparison of the qualifications which have a financial value to the employer. We call these intelligence, skill, initiative and personal qualities.

The rating scale is a constant and reliable gage of

RATING REPORT

NAME John Doe NUMBER 163

OCCUPATION Lineman DEPT. Elec.Oper.

FOR PERIOD ENDING May 27, 1920.

INTELLIGENCE	SKILL	INITIATIVE	PERSONAL QUALITIES	TOTAL
12	12	25	25	74

RATING AUTHORITY J. J. Clark, Foreman

REVISING AUTHORITY J. F. Cole, Supt. Elec.Oper. O.K.

RATING AUTH.	REVISING AUTH.	SUPT. PERSONNEL	GEN'L SUPT.	GEN'L MGR.	GEN'L SUPT. CONFIDENTIAL FILE	
JJC	JFC	JS	S	D&Z	S	

RATING REPORT ON WHICH THE FINAL RATING OF EACH EMPLOYEE IS MADE

an employee's merits and we believe that it completely eliminates the personal equation and justly determines merit because the rating scale calls attention separately to each of the several essential qualifications of an employee. The danger that judgment may be based on minor defects with a corresponding disregard for important virtues is reduced to a minimum.

PREPARATION OF A STANDARD SCALE FOR RATING EMPLOYEES

In order to rate an employee, make a list of ten or twelve persons within or without the company's service whose work is intimately known to the rating authority, who must be the foreman or the one directly in charge of the employee being considered. Disregarding all other characteristics, select from this list the person whose intelligence surpasses any other on the list. Write his name or initials on the line marked "highest" on the accompanying "Employees' Rating Scale." On the line marked "lowest" put the name of the person who is most deficient in this respect. Put the middle or average person on the third line and the persons who range in intelligence midway between the middle and the extremes on the other two lines. The highest person will be represented by a numerical value of 15, the high person by 12, the middle 10, the low 8, and the lowest 5. Proceed similarly in constructing a scale for the other three qualities. The names selected for the highest and lowest places on the scale must represent extreme cases—the best and the worst of the trade, occupation or duty known to the rating authority. Be sure also that the middle, high and low are equally distributed, for the scale is a measuring rod for human capacity and the points by which it measures must be at equal distances. It is essential that any person whose name appears upon the scale be a person who exhibits clearly and distinctly the qualifications in the correct degree for which you are using them. With a little experience the scale can be refined and perfected until it can be used with ease and confidence.

Persons who are called upon to rate subordinates in more than one class of work, trade or duty should make a separate scale for each.

After the rating scale has been made up we are ready for the second operation, or the rating of the employee, and it is essential that personal grudge, dislike, admiration and friendship be eliminated, for the future status of the individual being rated as well as the effectiveness of the entire personnel of the organization will be affected by the result.

To arrive at the rating compare the employee to be rated specifically and directly with those whose names appear on the rating scale. Try to have as clear and vivid an idea of both as possible. For instance, under "intelligence," on the exhibit, you will notice we have the five names. While rating John Doe under "intelligence," we compare him with those five names and consider only John Doe's intelligence as compared with the intelligence of those five persons. This is essential in order that no other qualities may enter into the rating on this specific quality of John Doe other than intelligence. When you have discovered the person with whom John Doe most nearly compares in intelligence, assign the number opposite that name as John Doe's rating for intelligence. Continue to rate then on the remaining three qualities in a manner exactly as above described.

The sum of the ratings given under each of the four general qualities is the employee's final rating. These ratings are set down on the rating report by the rating authority who is the immediate superior of the employee and sent to the revising authority, who is the immediate superior of the rating authority. The revising authority under this plan is not permitted to change the rating authority's figures, but if his rating is not identical with that of the rating authority, any difference will be noted in the proper space in red.

The scale is in no sense a percentage system. The average rating, if directions are followed carefully, will be about 62 points. Stated in another way, 62 points means an average employee in the class of work in which he is engaged, but this does not mean that all employees are worth only 62 points, neither does it mean that your organization average should show 62 points, because each employee is rated by comparison with persons in the same trade, work or duty and the ratings are relative to that only. There is no reason why an office boy should not receive as high a rating as the superintendent, as a rating of each represents the relation to work, trade or duty.

After having applied the above method of rating for a year, during which time two separate ratings have been made, we have found the following comparisons:

	First Half	Second Half
Intelligence	11.4	11.7
Skill	14	14.6
Initiative	16.5	17.4
Personal qualities	28.1	28.6
Total	70	72.3

This gives an idea of the accuracy and uniformity of the ratings.

Every employee is aware that ratings are made semi-yearly. Employees are also aware of the qualities considered and are at perfect liberty at any time to consult with the superintendent of personnel in order to determine whether or not they are satisfactorily measuring

up in each of the qualities considered. However, the actual rating figures are known only to the rating authority, the revising authority and the management. We believe by this means that many employees have been helped to increase their efficiency and to develop in the qualities wherein their shortcomings are most prominent. The ratings have also been a most valuable aid in deciding on employees for promotion or transfer and are used as a guide in the granting of wage increases.

Electrical Development Necessary to British Columbia's Progress

FIGURES showing the increased demand for electrical energy and the need at an early date of further hydro-electric development were published recently by the British Columbia Electric Railway Company. Based on the ELECTRICAL WORLD'S computation that the steam and hydro-electric development in the United States between 1920 and 1925 will reach 11,700,000 kw., involving a total capital expenditure of $3,706,000,000, the company has estimated the probable Canadian requirements as follows:

"Considering Canada's population as being one-twelfth of that of the United States, we must add nearly $309,000,000 to this figure, but as there is more electrical energy used per capita in Canada, the probability is that at least $500,000,000 will be required for Canadian electric power developments."

The problem of obtaining such a vast amount of capital for development, it is pointed out, must be faced by every community whose ultimate growth and prosperity are dependent upon an adequate power supply. The article continues:

Far from this being a problem solely for the electric power companies in the field, it is now recognized as the concern of the community as a whole, because the stagnation of electric power development means the curtailment of those services essential to community progress and the cessation of all industrial development.

It will readily be seen that if there is no electric power available there can be no manufactures; if there are no manufactures, there are no employees, no business for merchants, no clients for solicitors, no patients for doctors, no subscribers for newspapers—in fact, with the cessation of electrical development comes the cessation of community advancement.

Already the newspapers and national publications throughout the continent are taking up the question from the public's point of view. They realize that the restoration of the public utility companies' credit is essential for community welfare.

The question now may well be asked: How do we stand as regards electric power in British Columbia?

In reviewing the local situation it is necessary to remember that the construction of a power plant must be begun two to three years before it is expected to start generating. Financing must begin at even an earlier date.

During the last two years our demand on the mainland system has increased approximately 17 per cent a year. This demand has fallen off during the last few months owing to the industrial depression, but as this depression is conceded to be temporary and already passing, the demand for electric power is practically certain to continue increasing shortly at the same rate as before.

If the demand had increased without any lull at 15 per cent, our plants would be inadequate. By that time we would have been required to spend a million dollars on further power development. At best this investment cannot be postponed later than the summer of 1922, in order to be in readiness for the winter load of that year.

At the same time, other expenditures must be made for transmission lines, distribution lines, railway equipment and other public utility service.

Further, the million dollars will suffice to take care of the increased demand of only one year at the present rate of increase. Still other investments must be made immediately after. A new power plant costing $8,000,000 must be financed almost before the first million dollars is spent. As much more must be spent to transmit and distribute the energy from that new plant.

How is the British Columbia Electric Railway Company to obtain such capital? The answer is, by having the credit and good faith of the people of this province firmly re-established. Only by assuring the investor that his money placed in the public utilities of this province will earn a fair return and will be given every safeguard will capital be available for new electrical development. Unless this is done, electrical development will stand still, and the community likewise.

Explanation of Service Interruptions a Good-Will Asset

INTERRUPTIONS to electric service, no matter how infrequently they occur, are a source of annoyance and inconvenience to customers, and their attitude toward the utility becomes no more friendly through being left in the dark as to the cause of the trouble. With a view to building good will for the company and believing that the public is entitled to a prompt and complete explanation of an interruption to service, the Consumers' Power Company of Jackson, Mich., recently issued the following statement to the newspapers:

A series of severe lightning storms passed over the state this morning in the region of Ausable River.

The first storm, which occurred about 7 a.m., damaged a Consumers' Power Company transformer at one of the Ausable River dams. This piece of electrical apparatus was immediately switched out of service, and although the trouble was noticed by a momentary flickering of the lights, no interruptions to service occurred in Jackson. The power was off for a few minutes in the city of Flint.

The second storm occurred about 9 a.m. and caused one of the main transmission lines in the region of the Ausable River to fail. The power was off for several minutes in Jackson, Flint, Saginaw and Bay City while the faulty line was being switched out of service.

The load dispatchers of the Consumers' Power Company who are stationed at Jackson had advance notice of the storm and had plans made to sectionalize the line should the storm do any damage, and this is the reason why the interruptions were of such short duration considering the severity of the storm and the damage done.

This story appeared in the evening papers of the same day, and the public was thus informed as to the exact cause of the trouble and the precautions which the company had taken to minimize the interruption.

Another instance of the company's efforts to inconvenience customers as little as possible is shown in the accompanying advertisement announcing in advance the time and duration of an interruption to permit of changes for the betterment of the service.

INTERRUPTION TO ELECTRIC SERVICE

Between the hours of one and five o'clock, Sunday morning, March 13, there will be a necessary interruption on account of betterment of service.

Consumers' Power Co.

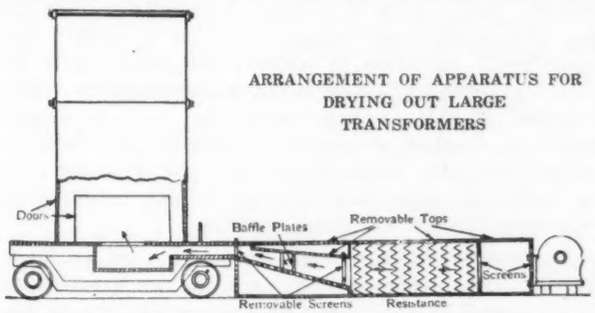
ADVANCE NOTICE OF SERVICE INTERRUPTION

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Experience in Drying Out Large Transformers.—S. H. ABBOTT.—The writer deals with experience in drying out a number of 6,000-kva., single-phase, 10,000-volt to 70,000-volt, oil-insulated, water-cooled transformers when the only available method was by external heating. He mentions two ways—(1) drying the transformer assembled in its case, and (2) drying the transformer outside its case and assembling it after it has been dried. The second method was used by the writer with an



ARRANGEMENT OF APPARATUS FOR DRYING OUT LARGE TRANSFORMERS

arrangement for applying heated air through the transformer when it was suspended in a housing as shown in the illustration.—*Electrical Journal*, March, 1921.

The Magnetic Circuit.—L. CHAMPNEY.—In this, the first of a series of two articles on the subject, the writer deals with the design and wave form of an alternator.—*Beama* (British Electrical and Allied Manufacturers' Association), February, 1921.

Generation, Transmission and Distribution

Internal-Combustion Engines.—C. S. DARLING.—The general considerations which determine the use of this type of engine for power generation. The advantages and disadvantages of each of the following types of engines are given in detail in tabular form: Steam engine or turbine, producer gas and engine, town gas or natural gas, crude-oil engines, paraffine and petrol engines.—*Beama* (British Electrical and Allied Manufacturers' Association), March, 1921.

The Modern Hydraulic Turbine.—FRANK H. ROGERS.—This discussion of the hydraulic turbine is treated under four headings—(1) modern requirements, (2) tests on models as an adjunct to design, (3) general features of design, and (4) special features of design. It is said that the requirements of the large central stations may be summarized as follows: (1) High-powered units, (2) high speed, (3) high efficiency, (4) reliability, (5) durability.—*Journal of Philadelphia Engineers' Club*, March, 1921.

The Diesel-Engine Industry.—L. H. MORRISON.—A comprehensive survey of the subject giving the distribution of Diesel engines by states and industries which is reproduced in abbreviated form here. Curves also show that this industry has grown up virtually in the last ten years. The author states that a wonderful field

DIESEL-ENGINE INSTALLATIONS IN THE UNITED STATES

	Central Stations		Ice, Pipe Lines and Irrigation, Waterworks, Colleges, Govt. Inst., Etc.		Cement, Chemical, Iron and Steel Mines, Flour and Textiles		— Total in — State	
	No. Engines	Total Hp.	No. Engines	Total Hp.	No. Engines	Total Hp.	No. Engines	Total Hp.
Maine	...	.....	...	.....	...	.....	....	.....
Vermont	...	.....	...	.....	...	.....	....	.....
New Hampshire	6	1,350	...	.....	...	.....	6	1,350
Massachusetts	1	240	7	790	...	.....	8	1,030
Rhode Island	...	.....	1	100	2	450	3	550
Connecticut	...	.....	2	400	...	.....	2	400
New York	13	3,825	22	3,565	11	2,115	46	9,505
New Jersey	2	140	23	4,020	5	920	30	5,080
Pennsylvania	...	.....	29	5,200	12	2,845	41	8,045
Maryland and D.C.	...	.....	9	2,580	...	.....	9	2,580
Delaware	...	.....	1	225	...	.....	1	225
Virginia	1	100	11	1,955	...	.....	12	2,055
No. Carolina	...	.....	...	.....	...	.....	0	.....
So. Carolina	1	200	...	.....	...	.....	1	200
Georgia	...	.....	1	200	...	.....	1	200
Florida	11	1,610	2	300	31	8,075	44	9,985
Kentucky	3	590	6	900	...	.....	9	1,490
West Virginia	...	.....	...	.....	...	.....	0	.....
Tennessee	1	100	...	.....	...	.....	1	100
Alabama	1	100	...	.....	...	.....	1	100
Ohio	7	2,440	12	1,745	...	.....	19	4,185
Indiana	8	1,425	...	.....	12	2,165	20	3,590
Illinois	11	2,385	12	5,270	...	.....	23	7,655
Michigan	...	.....	2	500	1	120	3	620
Wisconsin	9	1,415	2	450	...	.....	11	1,865
Minnesota	11	2,375	2	300	...	.....	13	2,675
Iowa	14	2,845	1	90	...	.....	15	2,935
Missouri	16	2,185	24	5,703	13	2,680	53	10,568
Arkansas	5	1,220	3	760	1	140	9	2,120
Kansas	40	5,970	63	25,830	21	9,780	124	41,580
Nebraska	20	4,590	2	190	3	480	25	5,260
No. Dakota	...	.....	...	.....	...	.....	0	.....
So. Dakota	19	4,305	...	.....	...	.....	19	4,305
Mississippi	...	.....	...	.....	...	.....	0	.....
Louisiana	26	3,725	37	7,640	2	730	65	12,095
Texas	92	19,975	182	34,035	34	8,425	308	62,435
Oklahoma	26	4,895	135	29,085	13	5,145	174	39,125
Montana	2	420	...	.....	...	.....	2	420
Wyoming	3	1,200	6	1,560	4	560	13	3,320
Idaho	...	.....	...	.....	2	460	2	460
Utah	...	.....	...	.....	3	100	3	100
Colorado	1	180	...	.....	5	1,140	6	1,320
Nevada	...	.....	...	.....	5	780	5	780
Arizona	25	7,190	20	2,070	27	13,980	72	23,240
New Mexico	6	1,270	...	.....	22	12,680	28	13,950
Oregon	...	.....	...	.....	...	.....	....	.....
Washington	...	.....	...	.....	...	.....	....	.....
California	6	1,640	13	1,735	8	1,565	27	4,940
Alaska	...	.....	...	.....	3	600	3	600
Total	387	79,905	630	137,198	240	75,935	1,257	293,038
Marine	...	.....	...	.....	...	.....	91	43,690
Export:								
Cuba and West Indies	...	.....	...	.....	...	.....	20	2,830
Mexico	...	.....	...	.....	...	.....	29	9,640
South America	...	.....	...	.....	...	.....	9	1,475
Philippine Islands	...	.....	...	.....	...	.....	8	1,680
Hawaii	...	.....	...	.....	...	.....	12	4,255
Canada	...	.....	...	.....	...	.....	4	1,800
China	...	.....	...	.....	...	.....	15	450
Africa, So. Sea Islands, Java, etc.	...	.....	...	.....	...	.....	9	1,349
Total Diesels manufactured in the United States							1,454	360,207

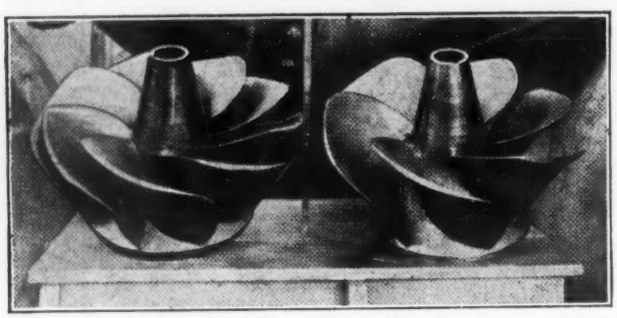
SUMMARY OF INSTALLATIONS BY INDUSTRIES

	Hp.	Per Cent
Oil pipe lines	98,823	30.7
Central stations	79,905	25.0
Mines and quarries	34,295	10.5
Exported	23,470	7.3
Chemical	19,840	6.2
Refrigeration	16,060	5.0
Waterworks, steam railways, etc.	13,580	4.2
Flour mills	10,920	3.4
General industries	10,625	3.3
Machinery	8,025	2.5
Electric railways	5,000	1.5
Textiles	1,050	0.3

exists for Diesel engines in units ranging from 50 hp. to 200 hp. to replace less efficient internal-combustion engines and small steam plants. He says that with fuel oil at 85 cents to $1.50 per barrel Diesel-engine economy cannot be attained by any of its competitors.—*Power*, March 1, 1921.

Technical Problems of Large Power Transmission Systems.—J. Biermanns.—Some very interesting viewpoints on the limits and the economy of large power transmissions, with special reference to a general electrification of Germany, for which an alternating-current voltage of 110,000 is regarded as sufficiently high. By means of simple formulas a few concrete examples are figured out in detail. The question of suitable protection against overvoltage is illustrated by an actual example of the release of a 10-km. traveling wave of 250 kv. along a 100-km. line, with all numerical values calculated. The beneficial action of oil switches with auxiliary contacts ("Vorstufenschalter") is mentioned in detail.—*Elektrotechnische Zeitschrift*, Jan. 13 and 20, 1921.

Present Trend of Turbine Development.—Lewis F. Moody.—The writer deals with a few phases of the turbine's evolution that are considered worth noting and then takes up the chief elements to be considered



NEW FORMS OF RUNNERS FOR HIGH-SPEED HYDRAULIC TURBINES

in the turbine of the present, which he considers the turbine of the immediate future. These elements are as follows: (1) A casing in which the water can approach the runner symmetrically, (2) a transition space provided between the guide vanes and wheel vanes, and (3) the passage of the water through the draft tube. He explains the use of the spreading draft tube by means of which the kinetic energy of the whirling component of flow in the water discharged from the turbine runner is partly regained. New forms of runners suited to the new types of high-speed turbines are shown in the accompanying illustrations. —*Journal Philadelphia Engineers' Club*, March, 1921.

Installations, Systems and Appliances

Some Thermal Characteristics of Electric Ovens and Hot Plates.—Ezer Griffiths and F. H. Schofield.—The British Engineering Standards Association recently issued a standard specification for electrically heated cooking ranges. An account of the thermal tests specified in the report and based largely on work at the National Physical Laboratory is given in considerable detail in this article. Conclusions regarding the experiments with hot plates are summarized as follows: (1) Vessels containing liquid for testing hot plates involve difficulties due to the necessity of stirring, heat loss due to evaporation, etc. It seems preferable to rely on metallic disks of known thermal capacity for such tests. (2) The disk should be of the diameter for which the hot plate is designed. (3) The apparent efficiency of the plate depends upon the mass of the disk. Hence one should use a receiving disk of thermal capacity roughly the same as the kettles or other utensils used in practice. (4) The major part of the heat transmission with the inclosed type of hot plate is apparently by metallic conduction. Consequently the test disk should have a plane surface. (5) Disk tests might be used for defining the minimum requirements for hot plates; for example, that for a certain energy consumption the hot plate should raise the temperature of the disk to a certain maximum within a certain time, and that the energy required to maintain the disk at that temperature should not exceed a certain amount. The energy limits would be fixed relative to the effective area of the plate. Specifications for tests of ovens should cover: (1) Maximum time permissible for the oven to heat up to a certain temperature (say 200 deg. C.) from room temperature for a certain watt supply; (2) variation in temperature from top to bottom; (3) permissible variation in temperature during a period of half an hour switching down to medium heat; (4) method of stating efficiencies in relation to cubical contents. Some interesting test data are given for both hot plates and ovens of British manufacture. —London *Electrician*, Feb. 18, 1921.

Arc-Welding Equipment in the Foundry.—W. W. Reddie.—The author asserts that the work which can be performed by the arc-welding process falls into three general classes—(1) cutting of heavy risers and sink heads from steel or iron castings; (2) repairing castings, such as the filling of blowholes or building up parts omitted from the original casting; (3) repairing foundry equipment. The treatment required by each of these classes is outlined, and it is shown that the same type of welding equipment may be used for all classes of work.—*Electrical Journal*, March, 1921.

Individual-Gear Drive for Heavy Looms.—G. F. Sills.—Experience is said to show that the individual drive is being increasingly used for light work and even for heavy work, mainly because it offers advantages which may be roughly summarized as a larger output per loom, a reduction in the number of breakages owing to irregular drive, a reduction in the time lost in stoppages, a cleaner product owing to the absence of oil and dirt from overhead bearings and a freer atmosphere, while at the same time a better quality of fabric is woven and power is consumed only while the machine is running. In addition, the absence of belts and overhead gearing makes the weaving shed a lighter and pleasanter place to work in.—London *Electrician*, Feb. 4, 1921.

X-Ray Examination of Materials.—J. R. Clarke.—A review of progress made in the examination of metals and materials for the revelation of flaws, including a description of the apparatus required and methods of procedure.—*Beama* (British Electrical and Allied Manufacturers' Association), February, 1921.

Considerations in the Application of Electricity to Textile Mills.—J. T. Randles.—The success of electric drive in textile mills is not entirely due to economic reasons, but is, in fact, a result of the study of its application along true lines of research. Much of this preliminary work, apart from its bearing on the suc-

cess or failure of the employment of electric driving, may eventually result in changes in textile machinery of a far-reaching character, especially as the time appears to be coming when more and more electric mills of the true type will be completed in which full advantage can be taken of the economies and conveniences given by that form of drive in a way that has not been possible where conversions or semi-conversions of older mills have been the rule, according to the author.—London *Electrician*, Feb. 4, 1921.

Standardization in the Testing of Welds.—F. M. FARMER.—A complete summary of standards in the testing of welds as developed principally by the Bureau of Welding in the United States.—London *Engineer*, Feb. 25, 1921.

Automatic Speed Control for Sectional Paper Machine Drive.—STEPHEN A. STAEGE.—The advantages of electric drive for paper machines are set forth, and control of motors is dealt with more particularly in regard to speed control.—*Electric Journal*, March, 1921.

Electrophysics and Magnetism

The Development of Magnetic Materials.—T. D. YENSEN.—The writer deals with the development by Robert A. Hadfield and others of silicon steel, which has had such a great influence on transformer construction and design. He also points out that permeability up to 40,000 instead of 8,000 and a hysteresis loss of 300 ergs per cubic centimeter per cycle for $B = 10{,}000$, instead of 1,500 ergs, are possible for certain alloys prepared by special manufacturing methods. He refers to the uses of nickel alloys and discusses improvements in permanent magnets.—*Electric Journal*, March, 1921.

Units, Measurements and Instruments

Distortion in Thermionic Tube Circuits.—The writer says that for some uses of thermionic tubes it is essential that a faithful reproduction of the input wave be attained. Examples are the employment of tubes as generators of high frequency current for testing purposes, telephonic applications and a variety of laboratory applications to quantitative work. The author investigates the extent to which a vacuum tube causes distortion and the conditions which must be met in order to reduce the distortions to a minimum.—London *Electrician*, Feb. 25, 1921.

Telegraphy, Telephony and Signals

The Reduction of Atmospheric Disturbances in Radio Reception.—LOUIS W. AUSTIN.—The atmospheric disturbances of radio reception on the Atlantic Coast of the United States are classified as to type, effect and probable origin. The static reducing systems of the Marconi Company (Weagant system) and of the navy (Austin, Taylor and Otter Cliffs systems) are described and relative performance data of these are given. The improvement in reliability of reception to be obtained by the use of these systems is considered.—*Proceedings Institute of Radio Engineers*, February, 1921.

Thousand-Mile Amateur Radiophone.—J. O. SMITH.—Detailed description of the development and operation of the set used at Valley Stream, L. I., the operator of which is said to have listened to concerts 925 miles (1,490 km.) away.—*Wireless Age*, March, 1921.

Range of Wireless Stations.—R. CHENEVIX TRENCH.—The main constants of wireless stations are investigated in relation to range. From the theoretical radiation formula for a dipole the practical radiation from an aërial is deduced. This is applied to the Austin-Cohen formula, and after considering the questions of radiation efficiency and the power required in the receiving aërial the range formula is arrived at. Limitations of this theoretical formula are discussed and the equations arrived at are applied to the solution of practical problems with ranges varying from 4 km. to 4,000 km.—*Journal Institution Electrical Engineers*, London, January, 1921.

Relation Between Atmospheric Disturbances and Wave Length in Radio Reception.—LOUIS W. AUSTIN.—The apparent wave length of atmospheric disturbances at different times of the day and year is studied, and the results obtained are shown graphically and by description.—*Proceedings Institute of Radio Engineers*, February, 1921.

The "Leader" Cable at Portsmouth.—J. J. BENNETT.—The functions of a "leader" cable are (1) to enable a ship to make a good landfall in thick weather, (2) to lead a ship up the harbor, (3) to lead a ship from open water through a restricted channel to open water on the far side, (4) to give warning of outlying dangers, and (5) to assist a vessel to keep a straight course from port to port and thus save fuel. It is understood that a project is under consideration for carrying such a cable across the short cross-channel route. The cable at Portsmouth has been laid along the eastern approach to the harbor, extending from a shore station in Fort Blockhouse and through Spithead to a point about 6½ miles (10.5 km.) south of the Nab—a total distance of 17 nautical miles. The apparatus is much the same as that installed along Ambrose Channel in New York and described in the ELECTRICAL WORLD for Sept. 4, 1920, page 492. It is said that experiments have been carried out in depths up to 30 fathoms. There is evidence that as the depth increases the strength of signals, and consequently the range, decreases. Further trials are necessary before the relation of depth and range can be definitely fixed, it is said. The greatest length of cable employed up to date is 40 miles (64 km.). It is considered that cables should not exceed this length, since with greater length the resistance of the cable is high and signals are also reduced by attenuation of the current in the cable. It has been found that pitching and rolling of a vessel do not materially affect the reception of the signals.—London *Engineering*, Feb. 18, 1921.

A New System of Short-Wave Amplification.—EDWIN H. ARMSTRONG.—The various possible known methods of amplifying incoming signals of very short wave length (below 600 m.) are described and their limitations considered. The new method then described consists (for continuous wave reception) of the following steps: (1) Heterodyning, with the production of a beat frequency which is itself a radio frequency (for example, 100,000 cycles per second); (2) rectification of the beat current; (3) amplification at the beat radio frequency, preferably by a tuned amplifier; (4) audio frequency modulation of the amplified current; (5) rectification of the modulated current. For reception of damped wave or radiophone signals the fourth step is omitted. It is shown that in this case the quality (characteristic tone) of the incoming signals is preserved—*Proceedings Institute of Radio Engineers*, February, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

California Tax Bill Followed by Petitions for Higher Rates

THE passage of the King bill, heavily increasing California corporation taxes, has been followed by formal complaints from various electric light and power companies that their slight margin of net revenue and the tremendous claims of urgently needed new construction will not permit them to operate except at increased rates or with the continuation of war-time surcharges. These complaints are now being adjudged. The new law increases public utility taxes about one-third.

Puget Sound Co. Issues $13,734,000 in Refunding Bonds

A NEW issue of $13,734,000 of twenty-year general and refunding mortgage 7½ per cent bonds of the Puget Sound Power & Light Company came on the market this week at 97½, yielding about 7¾ per cent. Securing the bonds is a mortgage covering substantially all of the property of the company. The bonds are issued for the purpose of retiring the entire outstanding issue of the company's 7 per cent three-year notes due June 1. The company agrees to expend or to set aside for maintenance and renewals annually, beginning with Jan. 1, 1921, 13 per cent of its gross revenue from operations. This provision is subject to revision every three years by agreement or arbitration. Any deficiency will be treated as a reduction from bondable construction.

New York Goes Back to Single Commission

AT THIS time, when certain political groups in other states are urging local commissions for public utility regulation, the State of New York has, with the exception of a transit commission for New York City, abolished the dual state commission regulation. Under the law passed by the Legislature which adjourned on Saturday last there is created a single commission for the entire state, consisting of five members appointed by the Governor for ten-year terms instead of five years as at present and at an annual salary of $15,000 each. A member of the commission may be removed only for cause and by concurrent resolution by both houses of the State Legislature, carried by a two-thirds vote. The Governor has no power of removal.

The commission is empowered to require the establishment of classifications of service, to fix rates either upon complaint or upon its own motion, and to suspend rates, forms of contract, rules, etc., and pending a hearing it may establish temporary rates.

The new commission was appointed last week. It will consist of former Comptroller William A. Prendergast of New York City, chairman; W. R. Pooley, Buffalo; Charles Van Voorhis, Rochester; Oliver C. Semple, New York, and Charles G. Blakeslee, Binghamton.

Surcharge Allowed California Companies Cut from 15 to 10 per Cent

THE surcharge of 15 per cent granted last June by the California Railroad Commission to the Pacific Gas & Electric Company and the Great Western Power Company because of the abnormal power situation then existing as a result of the drought has been cut to 10 per cent by the commission pending the completion of the hearing on the companies' application for permission to continue it in effect. The money collected under this charge must, however, be kept intact by the companies subject to the commission's final order.

Ideal Power Service from Viewpoints of Seller and Buyer

"WHO is the ideal customer for a central station and what service should he get?" was the question discussed by central-station men and power purchasers at a meeting of the Western Geographical Section of the Pennsylvania Electric Association at Pittsburgh April 15. The managerial and technical viewpoints of central stations were presented at the morning session, while the opinions of one steel-mill and one coal-mine official were presented at the afternoon session.

The necessity for establishing a mutual understanding between central stations and power users was the keynote of the address by G. M. Gadsby, vice-president West Penn Power Company. The customer, he said, should be acquainted with the fact that the central-station company is always ready to give engineering advice. While rates are complicated, they are necessarily so to enable an equitable charge to be made to all customers. If a customer will recognize the investment made to serve him, he will understand the readiness-to-serve charge. Facilities are not elastic without limit, and therefore customers should advise the central station of any large extensions so that more generating and distribution equipment can be provided. Customers should realize the need of reporting troubles quickly.

A desirable customer for the central station from the technical viewpoint was defined by E. C. Stone, assistant to the general manager of the Duquesne Light Company, as one who uses standard voltage and standard frequency with reasonable continuity and without high peaks. The conditions under which service can be given at a minimum expense are that the consumer takes alternating current at generator frequency and three-phase primary voltage near a main distributing point. His load should have high diversity, load and power factors and should require only ordinary regulation of

voltage and frequency. Mr. Stone advocated a rate based on these ideal conditions with multiplying constants for cases which are departures.

J. A. Coyle, general manager of the Universal Steel Company, in discussing the paper claimed that the rates for the steel business sometimes imposed heavy burdens on the mills. For example, a furnace must not have its demand limited. If power is not available in quantity and when desired, it is not so useful. A study should be made to reduce the off-peak charge. Moreover, some reduction of the demand charge should be afforded during periods of depression.

An ideal customer, according to J. S. Jenks, vice-president West Penn Power Company, should have full confidence in the central station and in other customers. When this condition exists every problem can be worked out equitably to all. In reply to Mr. Coyle, he said that a reserve or sinking fund might be set aside to tide over depressions and thus relieve idle consumers, but it is doubtful whether commissions would be willing to do so.

STEEL-MILL AND COAL-MINE VIEWPOINT

The viewpoints of one steel-mill manager, J. A. Coyle, and of a coal-mine representative, W. L. Affelder, were the basis of the discussion during the afternoon.

Mr. Coyle, who is a sincere enthusiast in the use of central-station power, outlined some of the things which happen when power is interrupted in a steel mill. Metal may freeze in the furnace and occasion considerable delay, readjustment of metallurgical program, enormous increase in energy consumed per ton and decreased output. In a reversing blooming mill an interruption in service may allow the hot billet to burn the face of the rolls and, besides, to cool down to such a degree that it cannot be rolled so satisfactorily or at the minimum energy consumption.

W. L. Affelder, assistant to the president of the Hillman Coal & Coke Company, said that the use of central-station power in coal mines, although started in 1886, has been adopted slowly because such mines are usually not close to power lines and central-station companies have the disadvantage of interruptions. Now, however, the power loops and protective schemes have greatly improved the continuity of service. Because of the hazard resulting from interruption of service in gaseous coal mines, he said that substation men should be drilled carefully in giving reliable information regarding anticipated outages and duration of interruptions. Mr. Affelder complained of the complexity of central-station rate schedules and suggested that a simplified discount be establised. He disapproved of financing in which the user pays for equipment and gets a refund. He also believed there was a need of reducing the demand charge during a period of depression.

California Company Breaks Records Connecting New Customers

ANOTHER company broke all past records in March for connecting new customers to its lines. The San Joaquin Light & Power Company, Fresno, Cal., connected up lines for 4,500 applicants that were on the waiting list. During the month of March 24,858 acres additional were served by the company with power for irrigation, bringing the total now served up to 84,244 and adding 2,803 hp. In doing this the company has strung 150 miles of new line, with a total of 1,606 transformers installed.

Municipal Plant Interests Oppose Washington Utility Bill

AN EFFORT is being made by those opposed to the bill recently passed by the Washington Legislature relative to the obtaining of public necessity certificates by utilities to submit the measure to a referendum vote at the fall elections. The bill provides that no public service company may enter the territory of an established company without obtaining a certificate of public necessity and convenience. Established companies, however, are not required to have such a certificate for extensions. Municipal-plant interests opposed the bill.

Rate Reductions in Illinois Forecast

A HOPE that substantial rate reductions may soon be effected was expressed by Col. Frank L. Smith, the newly appointed chairman of the Illinois Public Utilities Commission, in his first public statement since his appointment. "As I conceive it," Colonel Smith said, "This commission is the protector of the public. Its duty is to get for the people who pay the bills the best service possible at the lowest possible price. Therefore, I hope, and I am sure those associated with me hope, substantial reductions may be brought about at an early date."

Narragansett Company May Increase Capitalization by $5,000,000

GOVERNOR San Souci of Rhode Island has signed an act permitting the Narragansett Electric Lighting Company of Providence to increase its capital stock from $15,000,000 to $20,000,000. The city of Providence withdrew its opposition to the bill upon the presentation by the company of proposed capital requirements during the next two years. These include the following: Oil-burning equipment in part, $110,000; new boiler house, $208,000; eight new boilers, $225,000; Elmwood-Hope transmission line in part, $51,000; miscellaneous additions to generating plant, transmission and distributing system, $156,000; new 45,000-kw. turbine installed, $980,000; storehouse, garage and office buildings, $350,000, and other outlays, exceeding, all told, $4,000,000.

Corporations May Practice Engineering If Licensed Engineers Are Engaged

AN EFFORT has been made to amend the law licensing engineers in New York, which was passed by the Legislature of that state last year, so as to limit the practice of professional engineering to individuals instead of corporations and partnerships. It was proposed to remove from the law that paragraph which provided that a corporation or partnership may engage in the practice of professional engineering provided the persons connected with the corporation or partnership in charge of the work are licensed as required under the law. Had this amendment been made as suggested it would have made it illegal for existing engineering corporations in New York to advertise or carry on any professional engineering. The bill now awaiting the Governor's signature carries a paragraph in part as follows:

"Nothing herein shall apply to a corporation, partnership or joint stock association, provided the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint stock associations shall be licensed engineers."

American Mission to London to Greet English Engineers

A DEPUTATION of engineers representing the four founder national engineering societies will go to London this summer to express the obligation the world owes the English engineers for the part they played in winning the war and also to make the award of the John Fritz medal to Sir Robert Hadfield at the opening meeting of the British Institution of Civil Engineers on June 29 for his invention of manganese steel.

The deputation will consist of Charles T. Main of Boston, representing the American Society of Civil Engineers; Col. Arthur S. Dwight of New York, representing the American Institute of Mining and Metallurgical Engineers; Ambrose Swasey of Cleveland, representing the John Fritz medal board of award and the American Society of Mechanical Engineers, and Dr. F. B. Jewett of New York, representing the American Institute of Electrical Engineers. Dr. Ira N. Hollis, president of Worcester Polytechnic Institute and past-president of the American Society of Mechanical Engineers, will accompany the deputation and bear the message from the American engineers.

Consumers' Power Starts Service on New 140,000-Volt Line

SERVICE was started on the new 140 000-volt line from Battle Creek to Owosso, Mich., by the Consumers' Power Company on April 3. This line links up the system with the 40,000-hp. steam plant now under construction at Battle Creek. It is expected that this plant will be completed by July 1.

With the completion of this addition the company has a 140,000-volt belt line extending from the Au Sable River, in the northeastern part of the state, through Bay City, Saginaw, Flint, Owosso, Battle Creek and Grand Rapids, to the Manistee and Muskegon Rivers in the northwestern side of the state. It is now possible to transfer large blocks of power between the different parts of the system, thus increasing the reliability of service.

The completion of this work, which was started in 1920, was made possible by the direct sale of securities to Michigan consumers. Up to April 9 approximately 3,000 individuals had been added as new stockholders of the company, and they have made available an additional $1,100,000 to the funds for construction purposes.

Residence Lighting to Be Shown at N. E. L. A. Convention

FOLLOWING its established custom of staging a lighting exhibit at the annual N. E. L. A. convention, the Lighting Sales Bureau will this year conduct a residence lighting demonstration. The residence lighting division, under the chairmanship of M. Luckiesh, is preparing this exhibit. It will consist of a large composite room and several booths on the mezzanine floor at the Drake Hotel, and its chief aim will be to demonstrate lighting effects and their possibilities.

Many novelties will be introduced and special emphasis will be placed on the charm and effectiveness of tinted light. An individual booth is being constructed which will show the extensive possibilities of portable lamps in the home. Another booth will take up various features of residence lighting. The aim is not only to depict the present possibilities but to indicate the future of light in the home. Wiring diagrams on a large scale will demonstrate the wiring and lighting of residences.

George B. Foster Sees Big Future for Electric Vehicle in Chicago

AN EMINENTLY satisfying future for the electric vehicle was outlined by George B. Foster, assistant to the vice-president of the Commonwealth Edison Company, in a talk with an ELECTRICAL WORLD representative regarding the Chicago Electric Vehicle Show to be given during the N. E. L. A. convention in May and the early part of June. The Commonwealth Edison Company, which is supplying the space for the exhibit free of charge, sees in the electric vehicle, according to Mr. Foster, the ultimate method of city transportation, and it is sponsoring the show in an effort to spread more widely a knowledge of its advantages rather than in the hope of any immediate gain for itself.

The use of the electric vehicle, and particularly of the road and industrial truck, in Chicago is fast increasing, though as yet, according to Mr. Foster, the surface has only been scratched. There are at present about 4,400 vehicles in use, representing an increase of from 15 to 20 per cent over last year and an investment of $14,000,000. The 1,300 road trucks in use serve twenty branches of industry, some of the most important being department stores, dairies, packing houses, bakeries, coal and ice dealers and express companies. In almost no case where electric trucks have superseded gasoline-driven or horse-drawn vehicles has their use been discontinued. One large Chicago department store has a fleet of 281, and such is the saving accomplished by their use that the fleet is being added to as it becomes necessary. It is a common thing, Mr. Foster said, for operators of fleets such as these to express to the Commonwealth Edison Company complete satisfaction with the installations and to tell of savings of from 30 to 40 per cent as compared with other systems of transportation.

GEORGE B. FOSTER

"There are virtually no fields of city transportation in which the electric truck shows to disadvantage," said Mr. Foster. "Department-store, laundry, grocery, bakery and soft-drink deliveries are all of the short-haul, frequent-stop type, where the electric truck is especially successful, and they compose only a few of those that might be named. High speed is not especially desirable in vehicles used for city delivery, and eventually these fields will be dominated by the electric truck, which lasts longer, is almost free from repairs and costs very little to run. There still exists a great deal of prejudice in favor of the gasoline vehicle, particularly on the part of drivers, but wherever the elec-

tric truck has had an opportunity to show its advantages in any sort of city transportation this prejudice has been quickly overcome.

"The use of the industrial truck is fast becoming a necessity where any intra-plant hauling must be done, though its possibilities are far from being fully exploited. It is in this field that the largest percentage of increase in installations has been seen recently, and numerous problems of secondary transportation are being solved in this way."

Rhode Island Electrical League Starts Co-operative Campaign

MUTUAL promotion of electrical development was advocated at the first meeting and dinner of the Rhode Island Electrical League, held in Providence on the evening of April 15 and attended by about 100 men representing all branches of the industry in southern New England. William Wilson, Providence, presided, and addresses were given by M. F. Falk, chairman of the newly formed league; R. L. Huse, Providence; E. L. Millikan, Blackstone Valley Gas & Electric Lighting Company, Woonsocket; A. H. Allcott, Providence; W. E. Sprackling, Tubular Woven Fabric Company, Pawtucket; G. Schneider, Providence, and William L. Goodwin, assistant to the president of the Society for Electrical Development. It was announced that $13,600 has already been subscribed for the publicity and other work of the league and that $6,600 has already been paid in for the first six months' campaigning, now under way. It is planned to hold monthly meetings for discussion and increase of acquaintanceship, and manufacturers' representatives will be invited to address the league. Improvement of relations within the industry and education of the public along electrical lines will be furthered.

In his message to Rhode Island Mr. Goodwin condemned the sale by hardware stores and department-store dealers of sub-standard and off-voltage appliances.

Hoover Resigns from Presidency of the Engineering Council

ACCEPTING with regret the resignation of Herbert Hoover as its president, the American Engineering Council of the Federated American Engineering Societies, meeting in Philadelphia last Saturday, voted its appreciation of Mr. Hoover's leadership during the organization period of the council and his initiation of policies and effort. Mr. Hoover's reason for resigning the presidency was that the council by its constitution was necessarily engaged in furthering national activities which involve legislation and that he as a member of the executive branch of the government could not consistently direct such activities.

One of the most important matters before the council was the report of the committee on elimination of waste in industry. The first reports of its study will be ready by June. They are being put into final form.

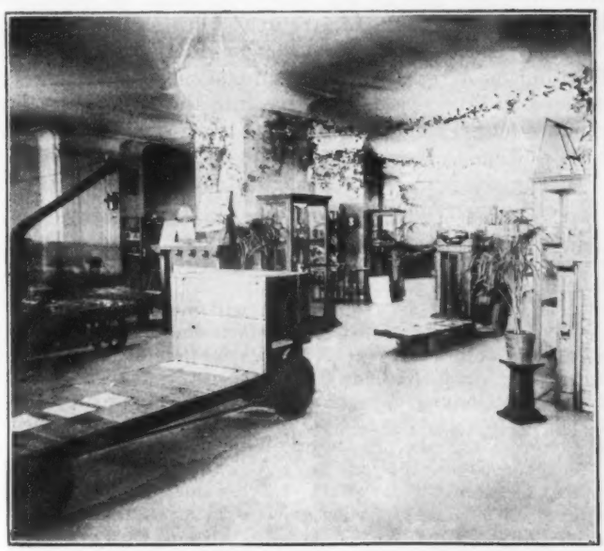
Plans for broadening the scope of the employment service were recommended and adopted.

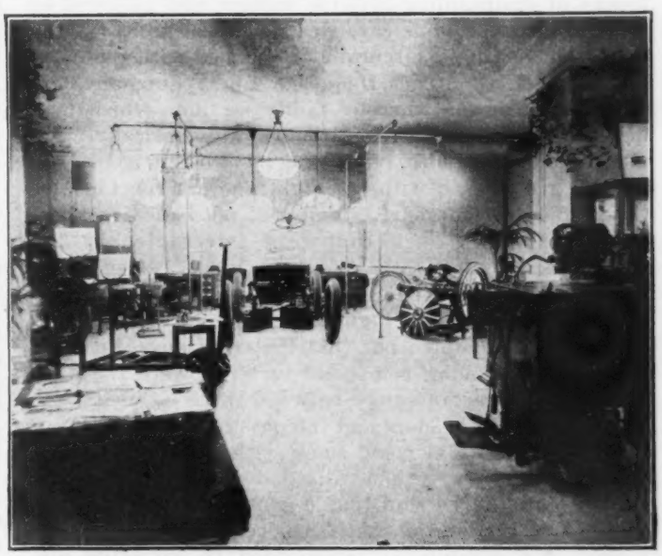
Dealing with the licensing and registration of engineers, Secretary Wallace's report said that this had been a very active feature of the council's legislative program. "We have emphasized," he said, "that the position of the council is that we do not believe such legislation to be necessary, but where it is to become a fact we are interested in seeing that the legislation passed is of such character as to be beneficial both to the public and the engineering profession."

The report of the public affairs committee, which was adopted, recommended continuance of the public works campaign, to promote which the national public works organization will be continued.

Three new member societies have joined the federation since the last meeting. They are the Boston Society of Civil Engineers and the engineering societies of Milwaukee and Duluth. The next meeting of the council will be held in St. Louis on June 3.

Newark Holds Successful Vehicle Show





VERY favorable reports are heard about the electric vehicle show which was held by the Public Service Electric Company in its big Newark, N. J., showroom last week. Twenty-two exhibitors demonstrated commercial and industrial trucks, passenger cars, batteries, charging equipment and accessories. Between two and three thousand people visited the show during each day and a number of excellent inquiries were received.

Frequency Problem and Colfax Station Topics at Pittsburgh Meeting

STEPS which the Duquesne Light Company has taken to increase still further the continuity of its service to steel mills and the problems which arise when 25-cycle steel mills endeavor to purchase 60-cycle central-station energy were the principal topics of discussion at the joint meeting of the A. I. E. E. and the A. I. and S. E. E. last Saturday in Pittsburgh. Some evidence of the interest shown was indicated by the presence of about 1,000 engineers who visited the new Colfax station of the Duquesne company in the morning and attended the technical sessions in the afternoon and evening. Between the two sessions an informal dinner was served at the William Penn Hotel, at which A. W. Berresford, president of the A. I. E. E.; E. S. Jefferies, president of the A. I. and S. E. E., and A. W. Thompson, president of the Duquesne Light Company, were the principal speakers. The keynotes of Mr. Thompson's address were the lack of understanding between central stations and their customers, the enormous investment required to serve steel mills in Pittsburgh alone, and the necessity of engineers helping in civic problems that will bring about an industrial peace. Mr. Thompson pointed out that $33,000,000 was necessary for financing the Colfax station and that $37,000,000 more will be needed to meet the demands for electrical energy in the next five years.

ASSURING CONTINUOUS SERVICE

At the first technical session, held in the afternoon at Carnegie Hall, Messrs. D. L. Galusha and C. W. E. Clarke, of Dwight P. Robinson & Company, Inc., presented a joint paper explaining how reliability and simplicity were obtained in the Colfax station* with relatively low investment and operating costs. In opening the discussion on the subject C. S. Cook, general manager of the Duquesne Light Company, pointed out that with coal costing three times what it did before the war more attention must be given measures for economy than formerly, but not at the sacrifice of reliability of service. F. C. Hanker emphasized the value of the high-tension ring or loop around Pittsburgh as a means of maintaining reliable service and referred to the fact that the same care was taken in laying out the important auxiliary circuits at Colfax as with the main circuits. E. C. Stone, Duquesne Light Company, explained the means whereby faulty sections which may develop in the "loop" are isolated automatically. He pointed out that with resistance installed in generator neutral ground and with the high inherent reactance of the system a dead short circuit will not cause such excessive current that it cannot be interrupted by the high-capacity circuit breakers provided. Hence reactors are not required under the present conditions.

F. Hodgkinson, Westinghouse Electric & Manufacturing Company, pointed out that the chief advantages of using three-cylinder, compound turbines were the division of temperature range between three elements, the simplification of headers and the possibility of operating the high-pressure element alone with fair economy.

In answering questions raised during the afternoon session, Mr. Clarke said that economizers would not be justified in this station until coal reached a price of $7 a ton. No difficulty is experienced in operating circulating pumps 15 ft. to 20 ft. above water level. Direct-current motors were used on stokers to insure the variable speed demanded and because the high pressure and temperature of the steam were obstacles to selecting reciprocating engines. Induced draft was not used because the natural draft provided is just as effective.

Mr. Galusha said that it actually cost $500,000 less to place the high-tension transformers indoors in this case. By maintaining the same spacings between conductors as outdoors a high safety factor and convenience of inspection and repair were assured.

STEEL-MILL FREQUENCY PROBLEM

Of the two papers delivered at the evening session that by B. G. Lamme,* chief engineer Westinghouse Electric & Manufacturing Company, dealt with the reasons for the adoption of 25 cycles in steel mills, the tendency toward purchasing central-station power and the frequency problems involved thereby. D. M. Petty, superintendent electrical department, Bethlehem Steel Company, dealt with the frequency problem from the steel man's viewpoint. Twenty-five-cycle motors have many advantages in steel-mill work, he said, but they should not stand in the way of growth of 60-cycle system if this is what is generally demanded. Although 60/25-cycle frequency changers may be objectionable because of cost, low efficiency and inability to handle short-circuit disturbances, he favors them in preference to scrapping all 25-cycle motors. As an alternative, however, Mr. Petty suggests that all auxiliary motors, furnaces and such apparatus be 60-cycle, that gear drives be supplanted and that direct-current or 15-cycle motors be used for low-speed operations.

J. Farrington, La Belle Iron Works, said that in the mill with which he is connected 25-cycle equipment has been gradually supplanted by 60-cycle in order to use purchased power. At present about 80 per cent of the installation is 60-cycle.

*See ELECTRICAL WORLD, April 2 and 16, 1921.

Federal Trade Commission Tells How Cost of Living Can Be Reduced

CAUSES tending to keep up the high cost of living and the remedies therefor are given in the report of the Federal Trade Commission to the President and alluded to by him in his recent message to Congress. Retail prices, it is stated, are not so low as is warranted by the reduced cost of basic production. President Harding as a result of the commission's report recommended to Congress an inquiry into the situation. The commission is of the opinion that it should ascertain costs and make them accessible to the public.

In summing up its report the commission suggests the following remedies:

Aside from the remedies which may be afforded by improved transportation and credit facilities, we suggest consideration of the following:

1. The passage of a bill which will meet judicial objections to the authority of this commission to continue its efforts to obtain and publish information respecting the ownership, production, distribution, cost, sales and profits in the basic industries more directly affecting the necessities of life—shelter, clothing, food and fuel—for the information of Congress and the promotion of the public welfare.

2. Vigorous prosecutions under the anti-trust laws, including a re-examination of the reviewable decrees already entered in such cases, with a view to strengthen them to meet present conditions, including also a closer scrutiny of the so-called open price associations to ascertain whether under the guise of beneficial associations they are in fact violating the law. Examination of associations of dis-

*Given elsewhere in this issue.

tributers to determine whether violations of law exist, particularly restrictions of co-operative purchases, and whether any of the activities of such associations are not of public service.

3. Positive encouragement of co-operative associations of agricultural producers and of co-operative consumers' organizations.

4. The passage of measures aimed at the elimination of unnecessary reconsignment and brokerage operations, including also "gambling in futures." Pyramiding of reconsignments and of jobbing sales, while not possible in present market conditions, was one of the causes of the buyers' strike, from which we now suffer, and may reappear whenever markets again become speculative.

5. Calling a conference of official representatives of the trading nations of the world to consider the question of clearing the channels of international trade so as to eliminate undesirable combinations and to promote fair competition.

6. Protection of the farmer against the more closely organized elements with which he has to deal by extending federal assistance in giving more adequate and timely information concerning foreign and domestic market conditions and in affording more ample and suitable local market and storage facilities for the serviceable conservation of perishable farm products.

Customer Relations, Financing and Appliance Sales Are Kansas Men's Topics

THAT the average central-station manager has an insufficient knowledge of economics and psychology was the belief expressed by W. J. Squires, chairman of the public utilities committee of the Kansas City Chamber of Commerce, at the opening session of the Kansas Public Service Association, held at Kansas City, Mo., on Wednesday. Mr. Squires based this assertion on investigations made by him. In his opinion, public feeling has been equally against private and municipally owned utilities because there has been a serious lack of public understanding of the problems of either. He suggested that engineering schools have paid too little attention to the education of men in handling utility management and public relations problems.

At the afternoon session, E. R. Conden of St. Louis and R. J. Long of Abilene discussed the sale of securities to customers. Mr. Conden said that the confidence of employees not only in the securities sold but in the company and its entire list of policies is a basic necessity for success in customer ownership movements. Short and intensive campaigns were favored and a well-trained force must be utilized. Mr. Long said that all of the Riverside Light, Power & Gas Company financing for several years has been done within the limits of its own territory, principally through the efforts of employees and by means of advertising. The subject of protection of markets came in for a lively discussion, the feeling of the meeting being that prices must be supported to the utmost to prevent loss of confidence.

J. L. Harvey of Wichita, in discussing the value of appliance sales from a revenue standpoint, brought out that the appliance sales of the Kansas Gas & Electric Company during 1920 had averaged $1.18 per month per residential customer and $1.05 for the first three months of this year. A method of stimulating sales on these properties was described. A bogie of $1.50 per month per residential meter in the smaller towns and slightly less in the larger towns has been established and, it is believed, will be reached over the whole year. The figure is higher in the small communities because of the more intimate contact between the operating forces and the public.

A joint meeting was held Thursday with the Missouri association. The Missouri association meetings continued Friday and Saturday.

Contractor-Dealers' Association in New Quarters

ON MARCH 29 the National Association of Electrical Contractors and Dealers moved into new quarters at 15 West Thirty-seventh Street, New York City. Because of its rapid growth in membership and the increasing amount of educational work in supplying information to members on cost accounting systems,

SECRETARY W. H. MORTON IN THE NEW HEADQUARTERS

improved merchandising methods and data on installations and construction materials, the association was badly cramped for space at its old location.

In the new offices, although only a small increase in floor area has been obtained, the general arrangement permits of a better and more efficient handling of office work.

Massachusetts Stock Equalization Bill Goes Over to Next Year

FOLLOWING a vigorous campaign for and against the so-called Burdett bill, introduced by the Massachusetts Gas & Electric Association and designed to equalize the cash and share capital of certain gas and electric utilities along lines previously described in the ELECTRICAL WORLD, the Massachusetts Legislature has declared against passing this act at the present session. A resolve substituted for the bill has been lying on the Senate table for a fortnight. This provides for an investigation by a special commission, including three senators, seven representatives and the Department of Public Utilities, to sit during the next recess of the Legislature and to consider whether any changes in the laws governing past or future issues of securities by gas and electric companies should be made in order to assist the department in rate regulation, to attract capital needed for development and for the promotion of the public interest. This commission would report its conclusions, with suggested drafts of acts, to the Legislature in January, 1922. It is expected that this investigation, if conducted, will open up the question of public utility financing in its broadest aspects, and that the fate of various other financing measures referred from this session to the next will depend upon the outcome of the proposed inquiry.

Atlanta to Go Ahead with Industrial Lighting Exhibit

THE Atlanta Electrical Association, whose membership consists of the leading electrical dealers, jobbers and manufacturers in Atlanta, has undertaken the installation in that city of the National Electric Light Association's industrial lighting exhibit. The installation will be made in co-operation with the Georgia School of Technology, which is furnishing the necessary space in the electrical testing laboratory at that institution. Practically all of the material required for the exhibit will be furnished without cost by manufacturers and jobbers in the respective lines. The exhibit is expected to be complete in time for the Southern Textile Association's convention in Atlanta on May 14.

Big Gains in New Services Reported by Barstow Properties

ANOTHER indication that business is picking up is afforded by the reports for the W. S. Barstow properties. During the month of March the Metropolitan Edison Company obtained 405 contracts for wiring old houses in Lebanon and Reading, Pa. This is a record month for the company.

During February the New Jersey Power & Light Company connected forty-nine lighting and power services and installed fourteen additional street lights in Succasunna, N. J.

The net gain in meters for the month of February on the system of the Binghamton (N. Y.) Light, Heat & Power Company was 111. There were also added several new power customers, varying in connected load from 1 hp. to 15 hp.

Chippawa Power Development Authorized by Ontario

THE Ontario Legislature on April 13 passed the final estimates authorizing the expenditure of $21,700,000 by the Ontario Hydro-Electric Power Commission for the purpose of completing the Chippawa power development at Niagara and Queenston. The progress report by R. S. Lea of Montreal, hydraulic engineer, said that the work is now only nine days behind schedule time as compared with fourteen days last September. There was every prospect, the report continued, of the project being completed and ready for operation by Sept. 1. It was now expected that the total cost would be $52,300,000. The present plans provide for the utilization of 15,000 sec.-ft. and the generation of between 450,000 hp. and 500,000 hp.

Electric Heating Show to Be Held in New York in June

AN ELECTRIC heating exhibit is to be held in the showrooms of the New York Edison Company, Irving Place and Fifteenth Street, New York, from June 6 to 11. This will be the first time that such a show has been held, and virtually all of the electrical appliances for industrial heating which have been perfected during the last five or ten years will be exhibited. Forty-one manufacturers have accepted the Edison company's invitation to take part, and at least a hundred different applications of electric heat will be shown. Cartridge units, tubular heaters, soldering irons, capping tools and branding irons and apparatus for candy makers and for use in shoe factories, printing plants and other industries will be exhibited and demonstrated. No charge will be made for admission.

American Association of Engineers Plans Convention

IT HAS been announced by the national headquarters of the American Association of Engineers that plans for the annual convention at the Hotel Lafeyette, Buffalo, N. Y., on May 9, 10 and 11, have been completed. The program for the first day includes the appointment of special committees, reports of officers and standing committees and the report of judges on the election of officers, which is now in progress. A discussion of chapter activities in practice by F. H. Newell, director of field forces of the association, will be followed by committee and council reports on employment, railroads, industries, federal, building and insurance trustees, salaries of engineers in public service and teaching service, education, services and fees of practicing engineers, legislation, chapter activities, municipal problems, water power and conservation, relation to foreign engineers, balloting and organization. A "smoker" and entertainment will be held in the evening.

On May 10 the report of the committee on revision of the constitution and bylaws will be received and discussed. In the afternoon a trip to Niagara Falls will be made. There will be discussion and voting on amendments to the constitution and bylaws on the morning of May 11. In the evening the annual dinner and installation of officers will be held.

To Harness the Columbia at Kettle Falls

WHERE the mighty Columbia River drops over a series of granite ledges at Kettle Falls, 72 miles north of Spokane, and 1,200 miles from its source in British Columbia, the Washington Water Power Company will probably install a hydro-electric plant. An engineering crew is in the field and the indications all point to the project proceeding. It is believed that 50,000 hp. are available.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

St. Louis Electrical Show to Be Joined with "Own Your Home Exposition."—The St. Louis Electrical Show this year will be held in conjunction with the "Own Your Home Exposition" from April 25 to May 1, under the auspices of the Building Industries Association, the electrical interests having decided to give no separate show in 1921. The purpose of the "Own Your Home Exposition" is to stimulate interest in building.

Thirty Years' Growth in Use of Electricity in Chicago.—Indicative of the enormous increase per capita in the use of electricity are figures gathered by the Illinois Committee on Public Utility Information showing that during the last thirty years the output of the Commonwealth Edison Company, which supplies Chicago with electricity, has increased 740 times. In the same period the population of the city has increased only two and one-half times. According to these figures the consumption of electricity per capita is now nearly 300 times what it was in 1890.

Storm Damages Canadian Power Plant.—A heavy storm almost equaling a cloudburst in violence broke over Parry Sound, Ontario, recently, increasing the spring flood in the Sequin River, on which the town has a hydro-electric installation, so greatly that the wing dam broke and the 2,200-hp. generating station was flooded, several employees at the plant having narrow escapes from the inrushing water. A channel 50 ft. wide has been blasted to divert the course of the water, and it is hoped that in six weeks from the day of the accident the machines will be dried, the dam repaired and the station in operation again.

Late Figures on French Water Power.—According to a consular report from Paris, a recent publication on the development of water power in France states that prior to August, 1914, the amount of hydro-electric power developed amounted to 750,000 hp. out of an available total of 8,000,000 hp. to 9,000,000 hp. By the middle of 1919 France was equipped to develop 1,165,000 hp., furnishing an average of approximately 770,000 hp. At that time more than 500,000 hp. was being developed, and it is estimated that in 1934 an average of more than 4,000,000 hp. will be reached. Much capital has been invested in the development of water power since 1918, and in three years more than 450,000,000 francs have been invested in forty-nine power-plant companies.

Electric Furnace Used in Making Record Run at University of Wisconsin.—The largest carborundum run ever attempted by the University of Wisconsin and possibly by any college in the country was accomplished recently in an electric furnace at the Wisconsin College of Engineering. Continually for sixteen hours electric current of 100 hp. at an average temperature between 4,000 deg. and 5,000 deg. Fahr. was passed through a charge of 600 lb. of sand and coke with a small amount of sawdust and salt. Sixty pounds of carborundum was produced and 250 lb. of fire sand. Eight students working in two-men shifts performed the work. Wisconsin is one of the few universities having equipment necessary for carrying on such experiments on a large scale.

Technical Education in Russia.—According to the London *Engineering*, Russia has adopted a remarkable expedient for producing the engineers of whom she stands in need. The soviet government puts the required supply at 4,500 annually. That number must be obtained from the engineering colleges and high schools, and it will therefore be necessary to fill all the colleges to their utmost capacity and to compel the students to work at the highest pressure. Technical education has been decreed to be a special kind of conscription, and the students are interned at the colleges and have to give an undertaking to devote all their time to studies. Any youth who appears at all likely to be able to follow the lectures will be accepted as a student without examination. As there are no longer any trade secrets, the students can work anywhere. A council of professors has, however, been bold enough to express doubt whether eight hours' work a day at the colleges and 200 hours' home work per month will enable the students to absorb the instruction given.

The State Commissions in 1921.—The defeat of a bill to establish a public service commission in Delaware leaves undisturbed that state's position as the only commonwealth that has no utility-regulating body of any kind. In Arkansas a Railroad Commission has taken the place of the former Corporation Commission, and efforts to abolish the commission in Illinois and other states have failed. Of the forty-seven state commissions eight—the Railroad Commissions of Florida, Kentucky, Louisiana, Texas, Mississippi and South Dakota, the Minnesota Railroad and Warehouse Commission and the New Mexico State Corporation Commission—have no jurisdiction over electric companies. Including the Public Utilities Commission of the District f Columbia and the territorial commissions of Hawaii, Porto Rico and the Philippines, there are forty-three bodies with jurisdiction over electric companies. Six of the nine Canadian provinces—Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario and Quebec—have public utilities commissions, British Columbia, Prince Edward Island and Saskatchewan being without them.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Society for Electrical Development.—The annual meeting of this society will be held at its offices, 522 Fifth Avenue, New York City, on May 10.

Cleveland Section, A. I. E. E.—On May 17 this section will hold its annual dinner, when the subject for consideration will be "Some Recent Developments in Scientific Research." C. F. Kettering of the Dayton Engineering Laboratories will be the speaker.

New York Section, I. E. S.—The New York Section of the Illuminating Engineering Society met on Thursday, April 14, when the use of lighting in the surgical, dental and ophthalmological fields was discussed in papers under different headings by four experts in their respective lines.

A. I. and S. E. E. Section Meetings.—The Chicago Section of the Iron and Steel association will meet on Monday, April 25, jointly with the A. I. E. E. "Electricity in Mining" will be the topic of the meeting. On May 7 the Philadelphia Section will hold a session devoted to "general ideas and discussions," every active member being invited to prepare a paper pertaining to the application of electricity to the iron and steel industry. The Cleveland Section on May 9 will hear a paper on electric safety tools prepared by H. P. Bush of the Bush Electric Company. Philadelphia is to inspect the Lehigh and Saucon plants of the Bethlehem Steel Company at a date in May not yet announced.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Chicago, April 25; Philadelphia, May 7; Cleveland, May 9.

A. I. E. E. Section Meetings — Chicago, April 25; San Francisco, April 29; Vancouver, B. C., May 6.

United States Chamber of Commerce — Atlantic City, April 27-29.

American Society of Civil Engineers — Houston, Tex., April 27.

American Association of Engineers—Buffalo, May 9-11.

Society for Electrical Development Annual Meeting—New York, May 10.

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond, Va., May 19-20.

A. I. E. E. Annual Meeting—New York, May 20.

American Society of Mechanical Engineers—Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A. Annual Convention—Chicago, May 31-June 3.

N. E. L. A., Pacific Coast Section — Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Protection from Confiscation.—The United States District Court for the Southern District of Texas has refused to allow the city of Houston to force the Southwestern Telegraph & Telephone Company to revert to the tariff in effect before the Postmaster-General raised telephone rates all over the country during the period of government operation. The court found the ordinance which the city sought to enforce to be confiscatory and held the company to be entitled to an increase which would enable it to earn a net return of 8 per cent on capital invested. (268 Fed. 878.)*

Commission's Findings Sustained Where Arbitrary Action Is Not Shown.—The city of Seattle having brought proceedings against the Public Service Commission of Washington to upset gas rates fixed by the defendant charged, first, that the evidence did not sustain the commission's findings and, second, that improper evidence was submitted. The Supreme Court of Washington refused to sustain either contention, declaring that the commission's decisions will not be disturbed by it in the absence of a showing of capriciousness or arbitrary action. The court assumed but did not declare that the commission should base its findings on proof submitted, and, making this assumption, found no evidence that such a course had not been followed. (195 Pac. 1017.)

Change from Hydraulic to Hydro-Electric Power Leads to Suit.—The Supreme Court of New York has decided in favor of the Cohoes Power & Light Corporation in a suit brought against it by C. H. Kavanaugh involving water rights owned by him. The action, which was of long standing and grew out of the substitution of hydro-electric for hydraulic power, involved the question whether 14.82 "mill power" or only 6 "mill power" had been acquired by the plaintiff and also a difference in rate between 50 cents and $1.50 per kilowatt-hour, or a total under a perpetual contract of between $6,000 and $7,000 a year. The plaintiff claimed that the right to the larger amount of power was confirmed by twenty years' adverse use and that the central-station company had offered the former owner of the rights in dispute the equivalent in electrical energy of 14.82 "mill power," thereby precluding its contention that only 6 "mill power," the amount named in the original leases, was called for.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Industrial Commission Cannot Fix Compensation for Injury Without Regard to Testimony.—In Schermerhorn vs. General Electric Company the defendant appealed from the action of the Industrial Commission in assessing damages under the workmen's compensation law in the case at issue on the basis of a 40 per cent injury to the use of plaintiff's hand, although the examining physicians had placed the ratio at from 25 to 33⅓ per cent. The Supreme Court of New York, Appellate Division, overruled the commission's decision as arbitrary, ordering that damages be fixed in accordance with the testimony. (186 N. Y. S. 835.)

The New Jersey Commission Case.—In McGran, Attorney-General, vs. Gaul, which involved the constitutionality of the Governor's action in removing from office the entire membership of the New Jersey Board of Public Utility Commissioners, the Court of Errors and Appeals of New Jersey found that the power of removal bestowed upon the Governor by the public utilities act was not unconstitutional as an encroachment on the judiciary. The court divided equally, thus sustaining the lower court, on the questions whether charges against commissioners should have been by formal pleading, whether the charges were rightly made against them as a board, whether intentional or willful neglect of duty should have been shown in order to justify removal, and whether the inclusion in the Governor's charges of acts or omissions which took place before the defendant, a member of the board, had taken office made the removal of the latter illegal. (112 At. 603.)

Possibility of Shock from Fallen Wire Question for Jury — Proximate Cause of Injury.—In Godbey vs. Grinnell Electric & Heating Company the plaintiff sought damages because of injury received when he endeavored to remove from his yard the end of a broken telephone wire which had been strung above an electric light wire and in falling had come and remained in contact therewith. The company held that as the telephone wire was lying along the ground it could not have caused a severe shock, and also that if such shock had been received the telephone company and not the electric light company would have been responsible. The Supreme Court of Iowa held that no question of law could be based on the first of these contentions, which was a matter of fact for the jury, and also that the proximate cause of injury was not the breaking of the telephone wire but the defective insulation of the electric light wire, the accident having been one of which the possibility should have been foreseen. If the telephone wire carried a current of its own which united with that from the electric light wire to cause the injury, that would be a concurring, not an intervening, cause of injury, and recovery might be had against either company or against both. (181 N. W. 498.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Preferential Rates Refused to City.—The city of Los Angeles will in the future pay for the power bought from the Southern California Edison Company in accordance with the schedule fixing the rate for electricity sold for resale. The city asked for a special rate, but the commission has held that "it is not entitled to any lower rate for the service as rendered than any other distributing company or municipality which is purchasing power in like quantities and under similar conditions."

Adequate Service Must Precede Higher Rates.—Declaring that a public utility company should not be permitted to procure capital for rebuilding from revenues derived through increased rates, the Wisconsin Railroad Commission refused to consider an application from a telephone company for an increase in rates in the absence of needed improvements, although standing ready to authorize any schedules fully to protect any reasonable investment necessitated in rebuilding to insure better service.

Value of Continuous Service.—In a decision fixing the valuation of the Wood River power plant at $311,380, though the capitalization of the property is only $245,000, the Public Utilities Commission of Idaho says: "The assurance of continuation of service is of even more importance than is the service presently rendered. Business and living plans are made with regard to it. Community and district growth are affected by it, and it may be said that service today is a convenience, while the assurance of continuous future service is a necessity."

Increased Rates Refused Because of Unsatisfactory Service.—Refusing to the Arkansas Light & Power Company an increase in electrical rates in the towns of Plummerville and Morrilton because of "extremely unsatisfactory" service, the Arkansas Corporation Commission said: "The commission understands that in order properly to serve the public a utility must receive a revenue sufficient to make this service possible, but the commission believes that conditions might arise by which the service might be so unsatisfactory that no increase of rates could be justified although it were shown that the company was losing money. . . . The commission does not feel that it would be just and right to allow the proposed increase in rates even though it is shown that the increase would not yield more than a fair return on the investment."

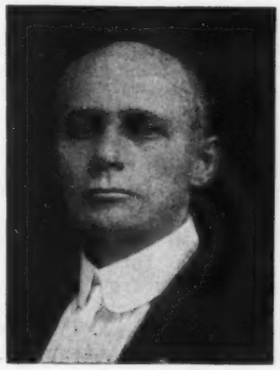
Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Dr. F. B. Jewett, chief engineer of the Western Electric Company, who is one of the best-known telephone engineers in the United States, has been elected to be a vice-president and director of that company. He will continue his present duties in charge of the company's technical forces engaged in manufacturing telephone equipment. Dr. Jewett, who was a lieutenant-colonel in the Signal Corps during the war and was decorated with the Distinguished Service Medal, was born in Pasadena, Cal., Sept. 5, 1879. He was graduated from the Throop Polytechnic Institute of Pasadena in 1898 with the degree of A.B. in electrical engineering. From 1898 until June, 1902, he was a graduate student in the University of Chicago, receiving the degree of Ph.D. in 1902. In the last two years of his post-graduate work he was research assistant to Professor Michelson, of the department of physics. From 1902 to 1904 Dr. Jewett was instructor in physics and electrical engineering at the Massachusetts Institute of Technology. His connection with the commercial telephone work dates from September, 1904, when he became transmission engineer for the American Telephone & Telegraph Company. While he acted in this capacity the loading of eight-gage circuits was perfected, phantom cables and phantom loading for open wires and cables were developed, the New York to Denver circuit and line was engineered, and so also was the Boston to Washington underground cable. In April, 1912, Dr. Jewett became assistant chief engineer of the Western Electric Company in charge of all development and research work. He has been chief engineer since 1916. Dr. Jewett was an advisory member of the special submarine board of the navy and contributed much toward the perfection of devices for detecting hostile submarines. The perfection of wireless telephony is one of the most notable undertakings completed under his direction.

F. B. JEWETT

H. L. Wills, electrical engineer and operating manager of the Georgia Railway & Power Company at Atlanta, was elected president of the American Association of Operating Engineers at a meeting held on April 5 in that city. This is a new organization whose aims and objects are to promote a better understanding of the problems of operating and maintenance engineers. The selection of Mr. Wills to head this organization is in recognition of his broad central-station experience in the engineering field. He entered the employ of the Georgia Railway & Electric Company in 1902 and remained with this company until 1907, holding positions as the head of the meter and repair departments. During that time he organized the testing department. In 1907 he resigned to become engineer and general manager of the Savannah (Ga.) Lighting Company. Since 1912 he has been connected with the Georgia Railway & Power Company and held various engineering positions of wide responsibility. On Feb. 1, 1919, he was appointed electrical engineer, a position which was merged with that of operating manager on Feb. 1, 1920. Throughout his career Mr. Wills has been identified with constructive work of the American Institute of Electrical Engineers, the National Electric Light Association and other societies, maintaining in all an active interest.



H. L. WILLS

Dr. Colin G. Fink of Yonkers, N. Y., who organized and has since directed the research laboratory of the Chile Exploration Company, has resigned his post as director. Dr. Fink recently invented an electrical process for the reduction of tin ores. His new insoluble anode is now being introduced at the large electrolytic copper plant at Chuquicamata, Chile. Dr. Fink was formerly in charge of the research laboratory of the Edison Lamp Works of the General Electric Company at Harrison, N. J. In 1903 he was graduated from Columbia University and went to Germany, where he studied under Ostwald, being graduated from the University of Leipsic in 1907 with the degree of Ph. D. On returning to America he entered the research laboratory of the General Electric Company at Schenectady, where he was engaged in work on the tungsten filament and the problem of ductile tungsten. A paper read by him before the Pittsburgh Section of the American Electrochemical Society in May, 1910, was the first announcement of the achievement of ductile tungsten and molybdenum. At Harrison Dr. Fink invented and developed the leading-in wire, a substitute for platinum, now used in every lamp factory in the world. His wire is also used in audions, mercury-arc rectifiers, X-ray tubes, kenotrons and other instruments. The annual resulting saving in platinum is estimated at more than $7,000,000. Dr. Fink is well known in electrometallurgical and electrochemical circles. He is a past-president of the American Electrochemical Society, is a member of the National Research Council and a fellow of the American Association for the Advancement of Science.

C. G. FINK

Frank A. Heermans has been appointed assistant secretary of the Public Utilities Commission of Illinois to succeed G. E. Doying.

Lloyd E. Oneal, formerly assistant electrical engineer of Dwight P. Robinson & Company, Inc., consulting and construction engineers, is now manager of the industrial equipment department of Charles Cory & Son, Inc., New York City.

J. S. Colt, who has been manager of the Wilmington (Del.) Electric Appliance Company since its inception nearly two years ago, is leaving this post to take up similar duties in the preliminary planning of a new enterprise. Mr. Colt will be associated with the same interests which control the above company. He is to be succeeded by H. H. Saylor of Philadelphia.

W. J. Marshall, who recently resigned the position of sales manager of the Electric Construction & Sales Company, Cleveland, has been made promotion manager of the Erner Electric Company, electrical jobber, of that city. He will be in general charge of appli-

W. J. MARSHALL

ance sales promotion work. Before going to Cleveland Mr. Marshall was for eleven years connected with the Doherty interests as new-business manager in Toledo and Warren, Ohio. He has been prominent in both the N. E. L. A. and the Ohio Electric Light Association and in the work of the Electrical League, in which organization he served as chairman of the committee which so successfully launched the "home electrical" movement in Cleveland.

Herbert H. Skinner, for the past two and one-half years representative of the Westinghouse Electric & Manufacturing Company in Rhode Island and eastern Connecticut, with headquarters at Providence, R. I., has established offices as commercial engineer at 801 Union Trust Building, Providence, representing the Godfrey Conveyor Company, Elkhart, Ind. Mr. Skinner is a native of Rome, N. Y. His early experience included eighteen months' work in the testing department of the General Electric Company's Lynn works, a year's service as assistant chief electrician of the Rhode Island Company, Providence, and a year with the Edison Electric Illuminating Company of Boston. For ten years prior to his Westinghouse connection Mr. Skinner was employed as power engineer by the Narragansett Electric Lighting Company at Providence.

R. B. Bragg, formerly district manager of the Pacific Power & Light Company at Dayton, Ore., has been transferred to the Pasco (Wash.) office. Mr. Bragg succeeds Mr. Safford.

H. W. Cooper, formerly district manager of the Pacific Power & Light Company at Pomeroy, Ore., has been transferred to Dayton to succeed R. B. Bragg.

Robert Johnston, for four years representative of the Federal Electric Company in Salt Lake City, has been transferred to Oakland, Cal., as sales manager of that district.

Charles W. Reed has been appointed New England field representative of the Electric Motor Repair Company, Springfield, Mass., with headquarters at 29 Worthington Street.

Harry E. Marshall has been appointed Pacific Coast representative of the Mueller Electric Company of Cleveland, Ohio, manufacturer of Universal battery and test clips, with offices and warehouse at 332 Leavenworth Street, San Francisco.

Gaskell S. Jacobs, assistant chief engineer of the California State Railroad Commission for the past six years, has resigned his position and will enter into private practice as a consulting electrical engineer. During his connection with the commission Mr. Jacobs has taken part in many of the important investigations conducted in that time.

W. G. Merowit, application engineer, has recently been appointed district sales engineering representative in western New York, Erie, Pa., and nearby Canada for the Ward Leonard Electric Company's lines of resistance units, battery-charging apparatus, etc. Mr. Merowit also represents in that territory the Monitor Controller Company, Baltimore; the Roller-Smith Company, New York City, and the Union Electric Manufacturing Company, Milwaukee. His headquarters will be at 707 Ellicott Square, Buffalo.

M. D. Summer, to whom charge of the Buffalo district office of the Packard Electric Company of Warren, Ohio, was given on March 1, is well known to the electrical trade in the Buffalo district. He was born in Olean, N. Y., and was graduated from the Olean high school in 1911. From the Bliss Electrical School he entered the employ of the General Electric Company and later of the Olean Light & Power Company. He left the latter company to become successively agent, district manager and sales manager with the Pittsburgh Transformer Company and more recently sales manager for the Carbon Import Company. Mr. Haig, former manager of the Buffalo district, has been transferred to the home office at Warren, Ohio, in the capacity of manager of the service department.

H. D. James has been appointed manager of the industrial division of the Cincinnati district office of the Westinghouse Electric & Manufacturing Company to succeed F. G. Kirkpatrick, who recently resigned. Mr. James was graduated from the University of Cincinnati in 1906 and afterward spent five years with the Westinghouse company. In 1911 he left that company to become power engineer with the Union Gas & Electric Company of Cincinnati. Mr. James served in the war, and at the time of his re-entering the employ of the Westinghouse company was with the Chace Engineering Company of Cincinnati.

T. W. Peters, who recently resigned as chief engineer of the Chero-Cola Company of Columbus, Ga., has been appointed district representative of the Black & Decker Manufacturing Company for the Southern States, with headquarters in Atlanta, where a new

T. W. PETERS

branch office will be established. Previous to his connection with the Chero-Cola Company early in 1919 Mr. Peters was for twelve years commercial agent of the Columbus (Ga.) Electric Company. During that period he was active in electrical association work throughout the South. He has served as secretary of the Southeastern Section of the N. E. L. A. from its organization, with the exception of the year 1913, when he was elected president.

Charles R. Dodge has been appointed Western sales manager of the Lakewood Engineering Company, Cleveland, Ohio, with headquarters at 1215 Lumber Exchange Building, Chicago.

Roy Sadler has been appointed superintendent of shops for the Electric Motor Repair Company, Springfield, Mass. Mr. Sadler was formerly connected with the Nashua (N. H.) Light, Heat & Power Company; the Hartford (Conn.) Electric Light Company; Landers, Frary & Clark Company, New Britain, Conn., and the Hartford (Conn.) Electric Machine & Repair Company. His experience covers about nineteen years of activity in the central-station and industrial fields.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Ten per Cent Drop on Cross-arms

FOLLOWING the price reduction of 9 to 15 per cent on Rainier fir and long-leaf yellow pine cross-arms that was made on March 1 as announced in the March 19 number of the ELECTRICAL WORLD, prices have again been reduced. The decrease, which was effective April 11, amounts to about 10 per cent and applies to the representative prices that were quoted in the March 19 issue. This is the third general price reduction inside of two months and a half, the first, on Feb. 1, amounting to 15 per cent.

It is hoped that this latest price decrease will serve as a stimulus to demand, especially as it comes at a time when kindred lines, such as poles and line hardware, are also reduced. Up to the present time the market has remained very quiet, and although stocks are good and deliveries prompt consumers have not followed up their inquiries.

Southwest Electrical Market Shows Encouraging Activity

ARIZONA, New Mexico and northern Mexico are dependent almost entirely upon copper mining for their industrial prosperity. Cotton is a close second in Arizona, while cattle are raised in all sections. With the curtailment of copper production there has come a rather marked slowing down of all business. A few of the properties are being entirely shut down, although the majority of them will continue pumping and some development work, particularly in the high-grade ore-bodies, will be carried on.

Extensive additions to generating equipment, mills and hoisting equipment are being made in some places in Arizona. The United Verde Copper Company is just now completing work on a modern surface station and an underground hoist at Jerome. The Miami Copper Company at Miami, Ariz., has nearly completed a new hoist and mill which have necessitated the building of a new substation and additions to its generating equipment. The Phelps-Dodge Corporation is installing several Diesel engines—some being of 2,000 hp. In addition that company is building a new mill at Bisbee. At Benson, Ariz., the same company is building a powder plant, which has necessitated a generating station.

In New Mexico several hydro-electric projects are in contemplation for the early future. Among these is the utilization of power from Elephant Butte dam to supply the territory along the Rio Grande River, including the city of El Paso. Other hydro-electric projects are in the preliminary stages of arranging for finances. In the coal fields a new market is being opened up by the electrification of existing mines and by the prospect of erecting generating stations at the mouths of mines in such mountainous regions that transportation of the coal itself would be difficult.

El Paso is in a strong position to get a large part of the jobbing business in New Mexico, western Texas, Arizona and Mexico. A strong play is being made by El Paso merchants to get the business of the western coast of Mexico, which will some day be an important factor. At the present time this territory is being jobbed partly by El Paso, but also by Dallas, Denver and Los Angeles. The freight rates to Arizona, particularly, have been a serious handicap to the establishment of jobbing houses in that state, although consideration has been given to this. At the present time many of the mining companies buy their supplies from Chicago and other distant centers, complaining that insufficient stocks are carried nearer by.

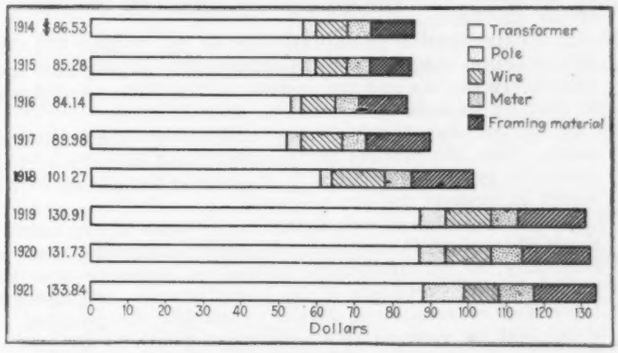
The sale of appliances and other household electrical devices has been somewhat hampered by the high prices. Stocks of almost all lines in the hands of retailers seem sufficient to meet demands. No difficulty is found in maintaining these as desired. In a few places active campaigns have been made in the past year to place such appliances as washers.

Little has been done in co-operative efforts to increase the use of household appliances. Although all the central stations carry a line of appliances and in a few instances push them actively, the dealers are quite free to develop.

Trend of Prices of Pole-Line Materials

IN AN analysis of its pole-line construction costs over the last seven years the Pacific Power & Light Company, in its April bulletin, presents some interesting figures in chart form as shown below. A typical installation in 6,600-volt, single-phase distribution-line construction was selected. It consisted of a 35-ft. untreated cedar pole and a span of 250 ft. of single-phase primary conductors. Included was a 5-kw., 6,600/220/110-volt transformer with all necessary cross-arms, insulators, pole-line hardware and grounding construction. An average length house service with 5-amp. type I-14 General Electric meter is also included, and all of this construction meets the company's usual standards.

"The total cost of this typical installation is taken from our general stores ledger as of January of each year," the



COST OF POLE-LINE CONSTRUCTION OVER SEVEN YEARS

bulletin says, "and represents the actual cost of the several items which go to make up this bill of material.

"It will be noted that most of the items have started to go down in price. This is especially true of wire and, to a small degree, applies to framing material. Since January of this year transformers have decreased 10 per cent and pole-line hardware has taken a drop of about 15 per cent."

In April hardware dropped 10 per cent, poles about 20 per cent and cross-arms 10 per cent. These decreases are not reflected in this chart because the stock on hand as of January was largely material that had been purchased previously and carried over from the preceding year, and a few months will have to elapse before these reduced costs can be reflected in a chart. The bulletin continues:

"It cannot be assumed that this chart shows the exact tendency in the complete cost of electric distribution system pole lines because labor costs are of equal importance and are not reflected in this presentation. It is safe to assume, however, that our average costs in the erection of distribution lines have increased at least as much as is shown in this chart."

Freight Prepayment Advocated by Supply Jobbers

AMONG the practical economies which the Electrical Supply Jobbers' Association seeks to put into effect is prepayment of freight by the manufacturer who sells "delivered" or "freight allowed." At a recent meeting of the association one jobber who has given the matter considerable study asserted that the adoption of the policy of prepaying freight by manufacturers would save the jobbing industry not less than $50,000 a year.

Under present conditions where manufacturers fail to prepay freight an immense amount of unnecessary detail, the jobbers state, is saddled on every party to the transaction. This is particularly emphasized where shipments are made direct to the jobber's customer.

The whole transaction of getting credit for the freight paid may take at a conservative estimate from four to six letters, it is asserted, as well as considerable extra time in searching and giving data concerning the invoice date, its number, etc. In addition each party to the transaction will make at least one ledger entry of the amount of the freight. All of this wasted time and expense, the jobbers feel, can be eliminated without harm to the manufacturer if the freight is originally prepaid.

Since this subject was first agitated some few years ago many manufacturers have sensed the jobber's position and have adopted the policy of prepaying freight, but there are some, however, who have not yet felt that they wished to take this step, and among some of the reasons advanced for hesitating to adopt this policy the following have been given:

1. Contention where goods are sold f.o.b. shipping point, freight allowed, that if the freight is prepaid by the shipper, then delivery to destination is guaranteed. This, the jobbers believe, would not be upheld in court, and furthermore they hold that if the contract of sale calls for delivery at shipping point a good delivery has been made by the shipper when he turns his goods over to the carrier whether he prepays the freight or not, and the goods in transit are the property of the purchaser.

2. Disinclination to pay the tax on the freight bill. To this objection the jobbers have answered by saying that they will absorb the tax and the amount of the taxes so paid may be charged to them on the face of their invoices.

3. Extra labor involved in actually prepaying each shipment. This, the jobbers further state, can be reduced to a minimum by arrangement with the carrier for weekly settlements of prepaid freight accounts.

As the situation stands today the jobbers of the country think that they themselves and their customers, and incidentally the manufacturers themselves, can save time and money in large amounts if the manufacturers will come to their way of reasoning; and it is confidently expected by them that as soon as this is brought home to the manufacturers prepayment of freight where goods are sold "delivered" or "freight allowed" will become a trade custom.

Returning Activity in Mechanical Refrigeration

INCREASING interest in electric refrigeration is reported by manufacturers of both residential and commercial types. Buying of the residential machines is generally at a rather low rate during the winter, but with the early warm weather this spring the market has already come back at a good rate. Consumer interest is increasing, the producers say, and prospective buyers are becoming convinced that mechanical refrigeration for home use has reached a stage of development where it can be used to great advantage. Not all producers are working at full schedule, but some of them report production capacity fully taken. Orders can be shipped in about four weeks.

The open winter and the small amount of natural ice cut have worked in favor of manufacturers of commercial machines, who have received some substantial orders so far and many of whom are working at a good rate. The activity of central stations in getting this load, much of which is synchronous-motor drive, is also a factor in increased machine output.

That the future must have much in store for mechanical refrigeration is shown by the expansion in producing capacity and in sales distribution of several representative manufacturers and by the recent entrance into the field of several new companies. Four to six weeks' shipments are being quoted.

General Reduction of Conduit Prices of from 5 to 10 per Cent

IN LINE with general reductions in steel prices within the past few months—and more particularly in view of the recent drop in prices of the United States Steel Corporation on merchant pipe and other products—general reductions on conduit have been made by manufacturers. The decrease ranges from about 5 per cent to slightly more than 10 per cent on different sizes and became effective on April 14, 15 and 18 with various producers. The number of the Pittsburgh basing discount card has in each case been increased by one, so that in different instances conduit manufacturers are now working on cards 45, 46 and 47.

The general increase in discounts that was made is the same in several instances, and amounts to two points on ½-in. conduit, three points on ¾-in. and five points on 1-in. and larger sizes, both black and galvanized. The discount on elbows and couplings is increased by three points.

Demand for conduit at the present time, manufacturers report, is very light, and new business has consequently fallen far below normal. As a result production is curtailed to a minimum, one large manufacturer operating on a 50 per cent schedule and another having closed down this department entirely for two months. Even on such a light operating basis manufacturers' stocks are too large, if anything, and shipments are of course immediate.

The outlook is for improvement in business, manufacturers think, but they also add that the returning market will probably be a slow process. The one thing above others needed to restore public confidence in the market and to stimulate building construction, it is said, is a general lower scale of wages.

The Metal Market Situation

BUYING in the copper market has not increased appreciably, but producers are content to maintain their prices of 12.75 to 13 cents per pound for deliveries over the second quarter. There is some increased domestic inquiry for small lots, but on the other hand foreign demand has fallen off with the cessation of German buying.

The lead market holds firm as to prices, but buying interest is lacking. Prices in the outside market at New York are about ¼ cent higher than the official price of 4.25 cents per pound.

NEW YORK METAL MARKET PRICE

	April 12, 1921	April 19, 1921
Copper	£ s d	£ s d
London, standard spot	69 0 0	69 15 0
	Cents per Pound	Cents per Pound
Prime Lake	12.75—13.00	12.75—13.00
Electrolytic	12.75	12.75
Casting	12.00	11.75—12.00
Wire base	14.50	14.50—15.00
Lead, trust price	4.25	4.25
Antimony	5.12	5.12
Nickel, ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	11.00	11.00
Zinc, spot	5.15	5.20
Tin	29.75	30.75
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9.50—10.25	9.50—10.25
Brass, heavy	5.50— 5.75	5.50— 5.75
Brass, light	3.75— 4.00	3.75— 4.00
Lead, heavy	3.50— 3.75	3.50— 3.75
Zinc, old scrap	2.87½— 3.00	2.87½— 3.00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

A BETTER tone is evident in the supply market, and from New England, St. Louis and the Northwest there are reports of increasing business. The Boston builders have thrown open their jobs and the response has been large. Building contracts doubled those of the week before. Chicago building is awaiting lower labor costs. Revival of plans by the industries in the South is reported because of the government aid in financing agricultural products. Merchandising conferences are stimulating business in the intermountain cities. New York is only holding its own.

With the price reductions of the Steel Corporation last week, structural steel is lower and an added incentive to large building is given. Reductions in tubular goods this week bring rigid conduit and fittings down two points. Reductions in line hardware, poles and cross-arms have reached all localities, and here and there local wire prices are a trifle softer. Repair work is moving wire and insulation. High-tension insulators are off on deliveries, but most other equipment is plentiful.

NEW YORK

The electrical trade in this territory at worst is holding its own, and in general the slight upward tendency previously noted continues. Spring sales of motor-driven socket appliances are very poor, but there is a sufficient volume of repair work being done to provide a fair demand for several staple items such as tape and rubber-covered wire. Conduit prices have just undergone a general reduction.

Buying for stock in virtually every line of goods is cautious and bids fair to remain so. Jobbers' stocks are pretty well in hand now, and there is not so much interchanging of supplies because the previously existing surplus has been largely overcome. Collections with the general run of customers are tight, but as jobbers have learned by experience to extend credit only to regular buyers, their report on the collection situation is favorable for the most part.

Loom.—Demand is slight with good stocks on hand. In 1,000-ft. lots the $\frac{7}{32}$-in. size sells for about $22 to $25 and the $\frac{1}{4}$-in. size for $24 to $27.

Conduit.—Demand is spotty among different jobbers, some finding it on the increase and others not. Fair stocks are held with very prompt shipments ruling. Price decreases have just been announced by manufacturers, as stated elsewhere in this issue.

Locknuts, Washers and Bushings.—Sales are fairly good with plentiful supplies on hand. In standard package quantities 50 per cent off list is generally quoted by jobbers.

Flexible Armored Conductor.—Stocks are adequate but not especially large, and though some houses report a little improvement in sales, general demand is light. The price of No. 14, two-wire, double-strip in 1,000-ft. lots holds steady at $62 to $66.

Lamp Cord.—The market is reported as stagnant on this item, and stocks vary from much too large down to a nominal amount. Prices cover a wide range, from $16.50 to $20.70 being quoted on 1,000 ft. of No. 18 cotton, twisted, and from $18.75 to $25 and even higher on No. 18 cotton, parallel.

Rubber-Covered Wire. — A slight spurt in demand is evident this week, with most jobbers making fairly good sales, especially on No. 14, single-braid, which brings from $7.50 to $7.75 per 1,000 ft. in 10,000-ft. lots. Stocks are good.

Tape.—Spring repair work has evidently increased sales a little as a fairly good demand is reported. Stocks are normal. Standard grades of friction tape in 100-lb. lots bring a fairly uniform price. Four jobbers quote 45 cents per pound, three quote 42 cents and one as low as 38½ cents. On rubber-tape prices there is more spread, however, as quotations range from as low as 36 cents per pound up to 48 cents, with 44 and 45 cents the happy medium.

Knife Switches.—Good stocks are carried, several jobbers having ordered fair quantities following price decreases the first of this month. The call, however, is light.

Household Appliances. — Demand for washing machines, cleaners, ironers, etc., is extremely slow this spring. Prices hold steady, and though stocks on hand are adequate, they are kept low.

CHICAGO

No appreciable change is registered in business in the Chicago district except that the long-continued period of business quiet is having the effect of deepening the pessimistic feelings of many dealers. Students of conditions, however, believe all signs point to better times in the very near future. Price adjustments by the steel interests which had the effect of lowering the price of structural steel $5 a ton, coupled with the previous 25 per cent cut in common brick, go a long step toward lower building costs. As regards the $25,000,000 in building permits which have been taken out this spring, actual work is being delayed pending lower costs. Labor is still considering a 20 per cent decrease, and should it become effective it seems certain that building will proceed with speed.

All classes of the trade are quiet. Contractors and supply jobbers are doing little and retail trade is low, apparently on account of persistent high prices. Of appliances, washing machines continue to be the best sellers, the great majority being sold on the deferred payment plan.

Bare Copper Wire. — Price bases remain unchanged. Quoted price by electrical supply houses is 16 cents per pound on No. 8 in 1,000-lb. lots. Not so much price shading is found since the Anaconda properties ceased production.

Insulated Wire.—Almost entire cessation of price cutting below the quoted figure of 19 cents per pound for No. 6 triple-braided weatherproof wire and $7.75 per 1,000 ft. for No. 14 rubber-covered is noted. All hands hold ample stocks. The feeling is that prices will be no lower.

Black Conduit. — Demand remains at a minimum and stocks are getting correspondingly heavy in jobbers' hands. Purchases, it is felt, will be very small pending new prices of steel tubing which will probably cause a new card on a lower base for conduit. Current quotation on ½-in. in 5,000-lb. lots is $64 per 1,000 ft.

Flexible Armored Conductor.—No price change and no increase in demand can be noted. Quotation is held firm at $62 per 1,000 ft. for No. 14 two-wire, in 5,000-ft. lots, few sales being negotiated.

Motors.—There is no interest manifested in motors. On the part of manufacturers prices are held firm, but many overstocked dealers are offering radical cuts, which, however, fail to attract business. General industrial inactivity rather than high prices seems to be the cause of poor trade.

Transformers. — With prices unchanged, business continues fair in the equipment for farm lines. Although no large orders are being booked, there is a continual string of small requirements.

Protective Apparatus.—In line with sales of transformers, cut-outs and arresters are moving nicely. Certain manufacturers have readjusted both price and discount sheets.

Cross-Arms. — New reduced lists became effective on cross-arms last week. N. E. L. A. specification two-pin arms, 3 ft. 2 in. x 3½ in x 4½ in., in less than 1,000 linear ft., are $66.79 per 100. Standard electric light arms, four-pin, 5-ft. x 3¼ in. x 4¼ in., are $73.83 per 100 in the same quantity. In larger lots prices are respectively $59.37 and $65.63 per 100. These quotations are f.o.b. Minnesota transfer point.

BOSTON

A decidedly better tone is evident in the market this week. The volume of trade has shown no marked increase, but several factors working toward increased business are in evidence. Boston building employers threw open their jobs a few days ago to open-shop workers, and the response has been large. Many delayed or stopped operations are now being resumed. Interest in domestic appliances has been quickened by the opening of the "Home Beautiful Show" at Boston, in which leading distributers occupy a massed central location. Collections seem to be holding their own. Building and engineering contracts in New England for the week ended April 12 totaled $4,070,000, compared with $1,955,500 for the preceding week. Stocks are somewhat spotty, although shipments from the factories are maintaining satisfactory deliveries except on high-tension insulators. Prices show downward movement in rigid conduit, cross-arms, rubber-covered wire, pole-line hardware and conduit fittings, with an upward change in wooden molding.

Storage Batteries.—Movement of batteries for automobile starting and lighting service is in good volume and shows increased sales. Prices are steady and stocks are being constantly replenished by factory shipments.

Motors.—A buyers' market still prevails and deliveries are excellent all along the line. Steady prices are reported.

Wire.—Rubber-covered wire has again weakened in price, No. 14 dropping to $7.50 per 1,000 ft. Monday on 5,000-ft. orders. Weatherproof wire is selling around 16 cents base on 1,200-lb. to 5,000-lb. orders, and bare is moving in small quantities at 16 to 18 cents base, with close competition for offered business.

Lamp Cord.—Sales are light and stocks much better than formerly. No. 18 cotton-covered sells around $25 in less than coil lots and at $18 to $20 in coil to 1,000-ft. lots. Silk No. 18 brings double these figures.

Rigid Conduit.—A new price schedule featuring reductions of 5 to 10 per cent was received Monday, effective immediately. All sizes of elbows and couplings were marked down three points. The new card quotes two points off the former on ½-in. pipe, three points off on ¾-in. and six points off on 1-in. to 6-in. pipe inclusive.

Flexible Armored Conductor.—Moderate-sized orders are being handled with steady prices, but larger quantities, running around 5,000 lb. or over, are moving at prices ranging from $55 to $60 per 1,000 ft. An increase in demand is anticipated following the resumption of building work.

Non-Metallic Flexible Conduit.—Dull trade continues, with steady prices. The $\frac{7}{32}$-in size brings $22 per 1,000 ft. in 5,000-ft. lots and the $\frac{7}{16}$-in. size $24. Deliveries are satisfactory from the buyer's standpoint.

Appliances. — Sales are responding to merchandising efforts and service work. The first quarter's sales of one of the largest retailers in New England slightly exceeded those of January-March, 1920. Stocks are in fine shape.

Pole-Line Material.—Cross-arms are easier in price, reduced quotations of about 10 per cent being noted among some jobbers. Hardware is off about 5 per cent; poles are quiet. Some construction work is being done, but central stations are mainly cultivating load on existing lines.

ATLANTA

Although it is impossible to point toward a specific instance as proof of the condition, nevertheless it is quite evident that the temper of business in general is showing a steady improvement in nearly all lines of activity. Although electrical jobbers report that their first week in April showed a falling off in the quantity of business, the second week witnessed a reaction that promises, if continued, to put April ahead of March in the volume of business done. The evident desire of the national government to assist in the financing of agricultural products has gone a long way toward restoring confidence throughout the section and in raising the morale of the agricultural communities. This situation is reflected by a revival of plans by industries for expansion, and a large increase in inquiries looking toward this end is being received. This is particularly true in connection with projects for electrically driven raw-water ice plants, which are badly needed to relieve the shortage in ice that exists in this section.

A slow revival in building is the result of the reduction in the cost of building material and labor, the moderate-priced home leading in this line.

Heating Devices.—This line is virtually dead, largely because retailers seem to be making no sales effort.

Safety Switches.—The usual steady demand for safety switches continues. With the exception of a reduction of 6 per cent announced by one manufacturer, no price changes have as yet been reported.

Insulating Material.—Repairs to old apparatus, in preference to purchase of new, have created a very active market for varnished-cambric cloth, rubber tape, friction tape and pressbroad. Inquiries show a steady increase and stocks have fallen to a low ebb.

Ventilating Equipment.—Early spring ushered in a brisk demand for ventilating equipment of all types, the movement this year being the earliest on record. The most popular sizes of fans are from 18 in. to 36 in.

Ceiling Fans.—A normal market is reported on this item, stocks and shipments being in good condition.

Fans.—These have begun to move in earnest, and jobbers are predicting a very heavy season in all sizes. Both stocks and shipments are reported satisfactory.

Static Condensers.—The action of power companies in requiring the correction of large customers' power factors has brought this specialty into prominence. The prospects are that an unusual quantity of orders for this class of apparatus will be booked by manufacturers and jobbers in the next few months.

Commercial Lighting Fixtures.—A reawakened activity is reported in this line, probably due to the educational campaigns by manufacturers.

Flexible Armored Conductor.—The movement is reported well sustained. Supplies are on hand in sufficient quantities, with prices on single strip, two-wire, No. 14, $77.50 per M ft.

ST. LOUIS

Increased volume of business is reported by several jobbers this week, though this applies rather to orders than to collections. One jobber reports an increase in orders of about 10 per cent over the average of the preceding few weeks, the betterment being general over the various lines carried. The cause for this change apparently lies in depleted stocks of retailers, for no appreciable increase in construction requirements has occurred. A small amount of residential building is under way, but it is far from normal. Manufacturers are building up their operations gradually, and some improvement in demand from this source may be observed in a few months. The wage controversy between the unions and the contractors is unchanged.

A 10 per cent reduction in the price of poles and cross-arms is the only price change reported this week. Stocks generally are in good shape. Collections remain on an average basis of sixty days.

Wire.—All jobbers report satisfactory movement of No. 14 rubber-covered, but the larger sizes are moving quite slowly. No. 14 can be purchased at any price from $7 to $8 per 1,000 ft. One large jobber is holding to the higher price and yet is reporting good sales. Both weatherproof and bare wire are selling on a base around 16 cents, and a fair demand is reported. Stocks are in good condition and the total St. Louis stock is being reduced through jobber interchange.

Poles and Cross-Arms.—Poles were reduced in price 10 per cent last week and cross-arms a fraction less than 10 per cent. Rainier fir arms, 3¼ x 4¼ in., are quoted as follows: 3-ft., $42.53 per 100; 4-ft., $56.70; 5-ft., $70.68; 6 ft., $95.05, all in lots of 1,000 linear ft., f.o.b. St. Louis. Improved demand on the part of utilities, and particularly the railroads, is reported. Inquiries are about normal and stocks are in satisfactory shape.

Lightning Arresters. — Delivery on compression-type arresters is much improved and immediate shipment can now be given. The demand is quite light, the expected spring demand so far having failed to develop.

Conduit.—There is no great demand for conduit in any size. Stocks in hands of contractors are fairly well depleted but there is no tendency to build them up. Half-inch black sells from $61 to $70 per 1,000 ft.

Flashlamps.—Steady demand, about normal for this time of year, is reported. Stocks are in good condition in both jobbers' and retailers' hands.

Dry Cells.—Demand continues fair, with stocks easily capable of taking care of it. Prices are firm, the No. 6 cell being quoted at $36 per 100 in barrel lots.

Safety Switches.—Steady demand is being experienced, though it is substantially larger than a year ago because of code requirements. Firm prices are maintained and stocks are in healthy shape.

Motors.—Demand for motors is extremely quiet because of the lack of industrial activity, and no difficulty is experienced in getting immediately all the motors wanted of any size, usually from local stocks.

SALT LAKE CITY—DENVER

The General Electric Company's merchandising conference, which gave demonstrations recently in Denver, Salt Lake City and Butte, attracted dealers, jobbers and central-station men from far and wide. It is generally conceded that the business-stimulating features were shown in this region at an opportune time and that the big conventions have had a salutary effect on the general business morale in the field of electrical merchandising. There are indications that point to a satisfactory solution of the employment problem in this territory. The railroads have already taken back several hundred employees, the farms are absorbing hundreds of other men; many have gone into selling, and a number are being employed by electrical dealers who will pay on a commission basis. It is believed that this increased activity in the way of selling appliances in homes will more than offset the slump in demand occasioned by thousands of men having been out of work.

As they find their surplus stocks coming to the point of depletion, jobbers are having occasion to place sizable orders with their factories. By the end of May it is believed that a normal plan of operating will have been reached. Retail merchants are still disposed to conservatism in stocking, showing a tendency to buy in just large enough quantities to meet current needs. The fact that they order with regular frequency shows that there is considerable consumer demand.

Bake Ovens.—Electric bake ovens are achieving wide popularity and use in hotels, restaurants, delicatessen stores and bakeries. Type 220, with capacity for 440 loaves per hour, retails at $1,800. Fifty ovens are now listed with one service station in Salt Lake City alone.

Flatirons.—The old and regular demand is reported by jobbers to be slowly coming back after a long period of sluggish selling. The disposition to wait for lower prices is not so deterrent a factor as it has been in past months. Irons of best quality are retailing around $8, and there is no likelihood of a reduction before midsummer.

SEATTLE—PORTLAND

In both Seattle and Portland business is experiencing something of a spring revival. The consensus of opinion appears to be that the bottom has been reached and the upward turn has been made. It is admitted, however, that a long period of fair to quiet business is ahead. In some places liquidation has undoubtedly run its course, but prices are still out of balance and no broad upward movement can be hoped for until all items that go to make up the cost of living have been proportionately lowered.

Jobbers report a slight revival in business. Line material is the most active feature. Collections continue slow. An analysis of the cause of this condition in the country districts shows that farmers are still holding their produce for higher prices. Producers want more for their new fruit crops than manufacturers say they can pay and make any profit on. Contracting is showing signs of improvement both in wiring and fixtures. Dealers continue to report poor business, although the tone is better than a week ago.

Grazing conditions for this season are above normal and stock is being turned out to range. Shearing is under way with a good yield and sheep men report stock increases to be unusually heavy. Lumber production in western Oregon and Washington is reported about 40 per cent below normal, indicating a gradual improvement. New business, shipments and local orders are much improved over the past few weeks.

Poles and Cross-Arms.—Pole-line construction is showing some activity, and indications from numerous inquiries are that attractive business will materialize during April and May. Power companies are buying to a considerable extent for proposed extensions, local stocks are in good shape and replacements are coming along nicely. Deliveries on order can readily be made because of better labor conditions and the resumption of operations in lumber camps.

Flexible Armored Conductor.—Sales are not heavy but show a slight increase, the major portion being used on small repair jobs. Prices fluctuate slightly.

Porcelain.—Although the volume of sales is below normal, a gradual increase in demand is noted.

Appliances.—Movement continues gradually increasing, but the volume is not heavy in Seattle. Tacoma dealers report gratifying response to an advertising campaign conducted in local newspapers.

SAN FRANCISCO

An unusually cold spring has somewhat affected crops in various parts of the state although they have been retarded rather than damaged.

Wires and Cords.—Weatherproof wire has just suffered a ½-cent drop and triple braid base sizes are now selling for $19.50 per 100 lb. in coil lots. Coast stocks are quite heavy and the demand is very irregular both for size and quantity. Lamp cord has just dropped 10 per cent, No. 18 cotton-covered twisted cord selling for $19.50 per 1,000 ft. in 2,500-ft. lots and No 18 silk twisted for $31.50 per 1,000 ft. in the same quantity, with the privilege of assortment of sizes and styles to make that quantity. Local stocks are very good. The rubber-covered wire market continues to show special conditions with heavy quantity buying the rule. Circular-mil prices were recently slightly adjusted, but basic conditions have been steady for nearly a month. There is a tendency to shop and to pool purchases.

Pole-Line Hardware.—Here is a line on which the sales are excellent. Coast stocks are very good and are supplemented by heavy factory shipments either to stock or quite frequently direct to the job.

Knobs and Tubes.—Local stocks are good and demand is very steady. This is mainly for unit packages, which sell for 10 per cent more on an average than barrel lots. New prices representing a 10 per cent decrease are now being quoted. No. 5½ split knobs bring $23.50 per 1,000 and ⅝-in. x 3-in. tubes $9 per 1,000 in barrel lots.

Schedule Material.—A great increase in business is reported by representatives of various manufacturers, who say that the orders are not only for larger quantities but are so comprehensively assorted that it is evident dealers' and jobbers' stocks are being regularly examined for shortages, from which want lists are systematically made out to bring depleted stocks back to par. About seven out of ten orders for sockets, one manufacturer asserts, are for socket bodies alone, which seems to prove that the separable base and cap principal has been successfully put across.

Fixtures.—"Brascolites" and "Aglites" have been slightly revised downward on list and consumers' discounts in smaller quantities bettered by 10 per cent. Dealers are receiving 2 per cent additional in larger quantities. Local stocks are large and well assorted.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Company to Make Ventilating Fans

The Johnson Fan & Blower Company has been organized, with headquarters at 115 South Clinton Street, Chicago. A. J. Johnson, formerly assistant general manager of the Ilg Ventilating Company, Chicago, is at the head of the new concern. The company will manufacture ventilating fans and blowers.

American Forge Up to Production

The American Forge & Manufacturing Company, 2433-41 West 48th Street, Chicago, has announced its readiness to supply copper forgings of all sorts, those for motors and motor control apparatus being its specialty. Production was started Oct. 1, 1920, and according to the announcement has reached the point where all orders can be filled. H. A. Jackwerth is president and W. S. Cohn is secretary and treasurer.

Sales Organization Changes of Sanford Riley Stoker

The sales management for Riley underfeed stokers and Murphy furnaces has been concentrated under one head. William Pestell, formerly Western sales manager with headquarters at Chicago, now becomes sales manager with headquarters at 1226 Woolworth Building, New York City. W. L. Bigelow becomes district manager of the Pittsburgh territory, while C. Lincoln Smith goes to Cincinnati in the same capacity. To serve better the territory in and around Kansas City, the F. M. Beeson Machinery Company, 308 Mutual Building, Kansas City, has been appointed sales agent for both Riley stokers and Murphy furnaces. Sales in Denver territory will be handled by the Stearns-Roger Manufacturing Company, 1718 California Street, Denver. The Boston, Buffalo, Cleveland, Detroit, Chicago, and St. Paul offices remain as heretofore.

National Foreign Trade Council's May Convention

The paramount questions before the eighth national convention of the National Foreign Trade Council, to be held in Cleveland from May 4 to May 7, it is said, will be the revision of the tariff, the financing of foreign trade, the merchant marine and the double taxation of investments made abroad by Americans in the interests of foreign trade extension. Representatives of several government departments, particularly the Treasury and Commerce divisions, are expected to be present to discuss federal policy toward foreign trade. Special interest centers in the probable activity of the War Finance Corporation, recently revised by Congress. It is expected that the question of exemption from federal taxation of all industries abroad in the interests of foreign trade extensions will be discussed by representatives from the Philippines, China and one of the Latin-American states.

Tripled Capacity for Batterman-Truitt Company

The steady growth of the business of the Batterman-Truitt Company, 736-8 West Monroe Street, Chicago, has made it necessary to take over additional manufacturing space in order to maintain its former service. Consequently the company has negotiated a lease covering additional floors in the Gordon Building, 730-38 West Monroe Street, tripling its facilities and equipment for the manufacture of ventilating fans and blowers. This increase is necessary, the company says, in order to handle the increase in business that is expected in the year 1921.

Sunbeam Electric Moves

The plant of the Sunbeam Electric Appliance Company will be removed to Evansville, Ind., from Milwaukee, Wis., it has just been announced. W. A. Carson of Evansville will be elected president of the company and E. D. Wemyss secretary.

Union Carbide & Carbon Consolidates Laboratories

The Union Carbide & Carbon Corporation, 30 East Forty-second Street, New York City, is consolidating its principal research laboratories into a single organization in Long Island City, N. Y. For this purpose it has leased for a minimum period of five years the entire second floor of a building which covers a ground area of 200 ft. x 600 ft. The net space available for laboratory activities will be in excess of 100,000 sq.ft.

The principal research laboratories which it is intended to consolidate at the present time are those of the Union Carbide Company and the Electro Metallurgical Company at Niagara Falls, the Cleveland and Fremont laboratories of the National Carbon Company and certain of the laboratory activities of the Linde Air Products Company at Buffalo, the Prest-O-Lite Company at Indianapolis and the American Every Ready Works at Long Island City. Only such activities will be transferred as can advantageously be carried on at a point remote from the several factories. These include chemical, electrical, mechanical and physical research.

The corporation in its strictly electrical activities manufactures carbon electrodes for electric furnaces, arc lights, projectors, welding equipment, etc., carbon and metal-carbon brushes, storage batteries, dry cells, flashlight apparatus and batteries.

Betts & Betts Doubles Space for Manufacturing

This week the Betts & Betts Corporation moves from its old quarters at 511-513 West Forty-second Street to 631-641 West Forty-third Street, New York City. This change will place all the manufacturing on one floor and at the same time double production capacity. Although the company's foreign business has dropped off to a large extent, its domestic business is on a par with that for this period of last year.

Brookfield Glass Company to Effect Liquidation

The plant and factory site of the Brookfield Glass Company, 2 Rector Street, New York City, is for sale, and the company announces that it intends to go out of the glass-insulator business. It was started in the year 1853.

The factory site of about 150 acres is situated at Old Bridge, Middlesex County, N. J., where there are buildings covering about 44,000 sq.ft. The company has two blast furnaces of the continuous tank size, 20 ft. x 30 ft. and 10 ft. x 14 ft., seven lehrs, four ovens, three stacks, etc.

It has a glass sand bank of 62 acres and plant at Jamesburg, N. J. About twenty-four patents and patent rights are included, which in the company's opinion give the right to use a glass feeder and to make tests for blown glass by machinery.

Otis Elevator's Report Shows Good Year

The Otis Elevator Company, New York City, closed its year ended Dec. 31, 1920, with earnings amounting to $4,645,749 after deducting all charges for patent expense, renewals and repairs for maintenance of plant and equipment less general and special depreciation. Net income amounted to $2,880,277. The company's inventories show a total of $3,033,787 in raw materials, finished parts, etc.

During the year all debenture bonds outstanding were retired either by purchase or conversion into common stock and all bank loans were paid. Common and preferred stocks total $15,985,087. The still unsettled condition in all in-

dustries makes it exceedingly difficult to estimate the probable resumption of substantial building activities, although there are indications in some sections of the country that new construction will not be much longer delayed. The reports from affiliated companies in Great Britain and Canada show satisfactory results for the year. On the Continent of Europe, however, the conditions are still so unsettled that but little elevator business is being done at the present time.

Crescent's "Acme" Sockets Sold to Parker & Son

The Crescent Electric Company, Inc., Mountain Grove, Mo., announces that it has sold the "Acme" molded weatherproof socket department of its business to J. H. Parker & Son, Inc., Parkersburg, W. Va., where future correspondence for "Acme" composition weatherproof sockets should be addressed. The Crescent Electric Company will continue in business, devoting its efforts to the manufacture of socket screw shells, fuse shells, fuse plug caps, fuse ferrules and other special parts for electrical manufacturers.

Electric Storage Battery's 1920 Consolidated Report

The Electric Storage Battery Company and the Willard Storage Battery Company, in their consolidated statement for the year ended Dec. 31, 1920, showed that their sales, less cost of manufacture and purchases and all expenses incident thereto, amounted to $12,134,614. This provided net earnings from sales of $7,549,011. After writing off inventory adjustments of $2,013,550 to reduce values to cost or to the market, whichever was lower, the total net earnings for 1920 before payment of federal taxes came to $6,157,091. At the same time the inventory account of raw material, goods in process and finished product amounts to $10,313,079. As an indication of conditions of business, $5,775,866 covers the accounts receivable.

New American Radio & Research Sales Headquarters

The sales headquarters offices of the American Radio & Research Corporation will shortly be removed from New York City to Medford Hillside, Mass., to provide for better co-ordination between the factory, laboratory and commercial organizations of the company. A branch sales office in charge of G. R. Martin will be maintained at 21 Park Row, New York City, the present location of the company in Manhattan. Reports from the factory indicate considerable improvement in inquiries for motors, switches and other apparatus manufactured under the company's "Twin-R" division of production. The outlook is excellent for early and substantial sales. The demand for the products of the "Am-Rad" division, it is said, has held up so well that the factory has been running on full time since Jan. 1. Interest among amateur purchasers of radio equipment continues unflagging.

New Company Formed by William S. Turner

William S. Turner & Company is a new organization formed at 1006 Spalding Building, Portland, Ore., to act as manufacturers' agent for the sale of high-grade equipment for electric railways, lighting and power systems, pumping and industrial plants; to make investigations, reports and appraisals and to design and construct public utility, municipal and manufacturing works. Mr. Turner will continue as heretofore his consulting engineering business in Portland.

The following manufacturers are among those represented: Heine Safety Boiler Company, De Laval Steam Turbine Company, Sanford Riley Stoker Company, C. H. Wheeler Manufacturing Company and the James Leffel & Company.

Expansion in Company and Plant of Switchboard Maker

The Eureka Stone & Marble Company, 179 West Maple Street, Columbus, Ohio, has been incorporated in the State of Ohio at $350,000 to take over the assets, good will, contracts and all other manner of business of the Eureka Marble & Tile Works Company, at the same address, that more capital may be obtained to take care of the rapidly increasing business and to carry out large contracts on hand.

The same line of business will be continued with many needed improvements in equipment and increased space for operations. It is the intention of the company to install the latest and improved marble working outfit and gradually to enlarge factory space as conditions warrant until it shall be in a position to build its own factory, a move contemplated in the near future. Standard moisture-proof switchboards will have a special space and the company hopes to double its output in their manufacture.

Southern Supply Jobber Pushes Range Sales

Following up the national advertising being done by the Estate Stove Company, the Piedmont Electric Company, Asheville, N. C., staged a three-day demonstration of electric ranges in March. The first two days were devoted to the prospective buyers of ranges and to those interested in electric cookery. The last day was given over to the company's dealers in the surrounding territory who had either sold ranges or shown interest in their sale and had an opportunity to make sales because of advantageous cooking rates in their localities. One dealer, on his return home, was instrumental in getting a favorable cooking rate in his town.

About 500 women attended the demonstrations, and their names were obtained through the medium of a contest which carried two appliances as prizes and which required a signature on a card.

E. Donald Tolles, national representative of the Electrical Supply Jobbers' Association, on May 2 will move his offices from 52 Broadway to larger quarters located at 165 Broadway, New York City.

The Davidson Porcelain Company, East Liverpool, Ohio, makes the "Eveready" nail-assembled knob and not the non-assembled knob as stated in last week's issue.

The Bleadon-Dunn Company, Chicago, has announced the opening of district offices at 20 West Forty-second Street, New York City, and 830 Washington Street, Boston. The New York office will be in charge of M. H. Sarben, formerly export manager for the Theodore Stave Company, and the Boston office in charge of William E. Alcott and J. Bernard Lynch. A complete stock of "violetta" and violet-ray machines will be carried at both offices.

The Dodge Sales & Engineering Company, Mishawaka, Ind., has secured the exclusive agency for Kenyon cotton rope for transmission drive in the United States and Canada. The manufacturers are William Kenyon & Sons, Ltd., Dunkinsfield, England.

W. R. Ostrander & Company, 371 Broadway, New York City, has extended its services in the South through the new agency of Paul Ebersole, Muskogee, Okla., who has taken on the company's line for Oklahoma, Arkansas and northern Texas.

The Electric Power Equipment Corporation, Philadelphia, announces the opening of a district office and warehouse at 215 Tenth Street, Huntington, W. Va., under the direction of L. T. Hall, who has been with the company (formerly Lewis & Roth) as superintendent of construction for several years.

The Corliss Carbon Company, Bradford, Pa., manufacturer of carbon brushes, has increased its capital stock from $500,000 to $1,000,000.

The G. E. Engineering Company, Inc., contracting engineers, New York City, announces the removal of its offices to 449 West Forty-second Street on April 1. The change is made necessary by expansion of business.

The Commercial Truck Company, Philadelphia, announces the removal of its plant and general offices from Twenty-seventh and Brown Streets to its new plant at Hunting Park and Rising Sun Avenues. The service department of the company remains in the same location, at Girard Avenue and Twenty-seventh Street.

The Electrical Industries Manufacturing Company, 328 West Forty-first Street, New York City, has filed notice of increase in capital stock from $40,000 to $100,000.

The Underwriters' Laboratories, Inc., have arranged to transfer their Coast agency to the offices of the National Board of Fire Underwriters, 205 Merchants' Exchange Building, San Francisco.

The Crane Company, 836 South Michigan Avenue, Chicago, has recently established offices in the following cities: Bearinger Building, Saginaw, Mich., in charge of B. L. Duffy; Goodrich Building, Phoenix, Ariz., in charge of O. H. Benner; 215 South Thirteenth Street, Lincoln, Neb., in charge of F. M. Ziegler, and 512 Second Avenue, East, Cedar Rapids, Iowa, in charge of E. C. Cole.

The Standard Paint Company, 95 Madison Avenue, New York City, manufacturer of weatherproofing products, announces the change of its corporate title to the Ruberoid Company.

The M. Propp Company, New York City, has moved from 108 Bowery to 524-528 Broadway, where it has an available floor space of 12,000 sq.ft. The company manufactures Christmas tree outfits, appliance plugs, miniature receptacles, etc.

The Driver-Harris Company, Harrison, N. J., manufacturer of electrical wires and other equipment, has filed notice of increase in capital stock from $3,000,000 to $4,500,000.

The Pittsburgh Electrical & Machine Company, Barker Place, Pittsburgh, has acquired the factory building of the Pittsburgh Trunk Manufacturing Company on Fontella Street, Northside, on a site 80 ft. x 100 ft. The company, it is understood, will establish new works at this location.

The Connecticut Blower Company, Inc., Hatrford, Conn., contemplates the construction of a manufacturing and foundry building, for which plans have been prepared. The cost is estimated at $62,500.

The Western Battery Manufacturing & Supply Company, 224 West Broadway, Enid, Okla., recently organized, is planning to establish a plant and will install machinery and equipment for the manufacture of storage batteries and accessories. The present plans provide for a daily output of twenty batteries. J. G. Wright is vice-president and general manager.

Foreign Trade Notes

TORRINGTON COMPANY EXPANDS IN CANADA.—Announcement is made at the general offices of the Torrington Company, Torrington, Conn., of the addition of A. W. Calendar to the Canadian sales staff of the Torrington electric vacuum cleaner organization. Mr. Calendar will make his headquarters at Toronto. The announcement follows the establishment of a new Canadian production unit of vacuum cleaners at Upper Bedford, near Montreal. F. A. Loudon will continue to act as representative for the Upper Provinces, with headquarters at Upper Bedford.

AMERICANS MEET STRONG COMPETITION IN GERMAN ELECTRICAL GOODS IN CHILE.—American manufacturers of electrical supplies are meeting serious competition from German sources in Chile, according to reports from the Department of Commerce. Many tons of such goods have been listed in the manifest of ships from Hamburg. Well-made sockets are being sold at 40 per cent less than the price of the American article. Electric fans, stoves, fuses, insulators and supplies for street railways are said to be available at prices equally advantageous. In this class of goods the Germans are able to meet competition on a basis of quality.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT IN FOOCHOW, CHINA.—According to reports from Consul Hanson of Foochow, Chinese in that district are interested in the organization of a hydro-electric plant to develop power from the Min River. The proposed capital is $5,000,000, and American participation is invited.

AMERICAN ELECTRICAL APPLIANCES PREFERRED IN THE NETHERLANDS.—In a report to the Department of Commerce Consul Frank W. Mahin of Amsterdam states that while there may be a market for all American products in the Amsterdam district the greatest opportunity is said to be available for American electrical machinery and electrical appliances.

INCREASE IN PRODUCTION OF ELECTRICAL EQUIPMENT IN SOUTH AUSTRALIA.—Owing to the great increase in wages in England and allied countries the South Australian manufacturers are able to compete on an almost equal footing with the British and foreign firms for manufactured articles, including electrical fittings, turbines and centrifugal pumps. In some of the manufacturing industries the number of factories has been doubled or trebled.

THE HARRY M. HOPE ENGINEERING COMPANY, Boston, has established offices in the Dominion Express Building, Montreal, to handle its Canadian business. George W. Saunders, formerly with S. Pearon & Sons, London, is Canadian manager.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of lighting-fixture manufacturers in Italy (No. 34,722) wishes to purchase brass tubing and bright, cold-rolled steel tubing, 28 gage and lighter, round and square, from ⅛ in. to 2½ in., outside diameter.

The Niacaraguan Consulate, 15 John Street, announces the arrival in New York City of José Antonio Tigerino, representing Tigerino Brothers of Chinandiga. Mr. Tigerino is in the market for 30-kw. and 45-kw. waterwheels and generators, 20 and 40-watt lamps, 1 to 23-kw. transformers, switchboard, cable and necessary accessories. Mr. Tigerino can be addressed at the consulate.

A mercantile firm in India (No. 34,728) desires to receive catalogs of electric-lighting apparatus and novelties, etc.

New Apparatus and Publications

RHEOSTAT.—The Ward Leonard Electric Company, Mount Vernon, N. Y., has developed a ribbon resistor unit—"Ribohm Unit"—for heavy duty rheostats.

FIXTURES.—C. G. Everson & Company, Chicago, is distributing a booklet on the subject of fashions in lighting fixtures for the home.

INSULATING MATERIAL.—The Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York City, is distributing a four-page leaflet describing Ebony Asbestos Wood for switchboard panels, bases, etc.

HAMMER DRILL.—The Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York City, is distributing bulletin 639, covering its BQ-46 hammer drill.

AUTOMATIC MOTOR.—Bulletin No. 2008 recently issued by the Triumph Electric Company, Cincinnati, describes its "TR" self-starting automatic motor.

BAKE OVENS.—The Westinghouse Electric & Manufacturing Company has issued leaflet 3436, describing its automatic electric commercial bake ovens.

CONNECTOR PLUG.—A cord connector and motor attachment plug of smaller size than the standard devices has recently been designed by the Cutler-Hammer Manufacturing Company, Milwaukee, for use with socket appliances.

COMBUSTION.—"The Burning Question" is the title of a new book issued by the Green Engineering Company, East Chicago, Ind., dealing with the question of proper combustion. "The Green Cast Iron Hopper Book," recently issued by the company, describes the cast-iron and structural-steel hopper.

COMPENSATORS.—The Industrial Controller Company, Milwaukee, is distributing bulletin 108, covering its type C alternating-current compensators.

SCREW THREAD STANDARDS. — The Bureau of Standards, Department of Commerce, Washington, D. C., is distributing miscellaneous publication No. 42, entitled "Progress Report of the National Screw-Thread Commission." This report contains standards for screw threads ascertained and established by the commission.

CHRISTMAS TREE LIGHTS.—The Diamond Electric Specialties Corporation, Newark, N. J., is putting on the market a line of eight-light electric decorative outfits which can be plugged together to form up to thirty-two-light outfits.

RADIO APPARATUS. — The Acme Apparatus Company, Cambridge, Mass., is distributing bulletins Nos. 101, 103, 107, 113, 117 and 119, covering its different types of radio transformers and accessories.

INDUCTION COILS. — The American Radio & Research Corporation, Medford Hillside, Mass., has issued bulletin P-3, describing the "Amrad" induction coil sets.

RADIO EQUIPMENT.—The William J. Murdock Company, Chelsea, Mass., is distributing bulletin No. 20-A, describing its radio apparatus.

INDUSTRIAL TRACTOR. — The Baker R & L Company, Cleveland, is distributing a folder on its new series C electric tractor with duplex compensating suspension.

New Companies

THE MIDWAY LIGHTING & IMPROVEMENT COMPANY, Midway, N. C., has been incorporated with a capital stock of $50,000. C. C. Stonestreet is interested in the company.

THE SLATON LIGHT COMPANY, Slaton, Texas., has been incorporated with a capital of $15,000 by Foster Carroll, J. T. Elliott and L. H. Fuller.

THE FRANKLIN ELECTRIC PRODUCT COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $25,000 by H. A. Troyan and G. F. Kusel.

THE RICHMOND MUTUAL LIGHT & POWER COMPANY, Willard, Ohio, has been incorporated with a capital stock of $10,000. W. C. Miller is interested in the company.

THE SALAMANCA CENTRAL ELECTRIC COMPANY, Salamanca, N. Y., has been incorporated with a capital stock of $10,000 to operate a local electric light and power system. The incorporators are A. L. Varley, S. W. Coston and A. E. Frieger.

AGENS & COMPANY, Newark, N. J., has been incorporated by Edward B. Tousek, Sylvester H. M. Agens, Newark, and F. Raymond Powell, Irvington. The company is capitalized at $200,000 and proposes to manufacture lighting devices.

THE MOYER-SHEWEY-THURSTON ELECTRIC COMPANY, State Street Bank Building, Charleston, W. Va., has been organized with a capital stock of $100,000. H. D. Moyer is president; J. G. Shewey, vice-president, and J. A. Thurston, treasurer and general manager.

THE NORTH JACKSON LIGHT, HEAT, POWER & WATER COMPANY, North Jackson, Ohio, has been incorporated with a capital stock of $10,000 by N. Shipley, S. T. Stewart, G. L. McMillin and others.

Record of Electrical Patents

Notes on United States Patents

(Issued March 29, 1921)

1,373,127. SCREW-SHELL-CONTACT MOUNTING FOR ATTACHMENT PLUGS; Edgar H. Freeman, Trenton, N. J. App. filed July 21, 1919. Quickly assembled.

1,373,208. THERAPEUTIC ELECTRIC VIBRATOR; Stephen D. Smith, Hercules, Cal. App. filed July 8, 1920. To use very small current.

1,373,209. AUTOMOBILE-LAMP-DIMMING DEVICE; Frank E. Spelman, Malden, Mass. App. filed Feb. 12, 1920.

1,373,241. STORAGE BATTERY; Russell L. Heberling and Walter E. Holland, Philadelphia, Pa. App. filed June 2, 1920. Easily detached cell connector.

1,373,273. ELECTRODE FOR ELECTROLYTIC RECOVERY OF METALS FROM SOLUTIONS; Urlyn C. Tainton, Martinez, Cal. Precipitating gold and other metals.

1,373,314. SHORT-CIRCUITING SEGMENTS FOR ELECTRIC MOTORS; John A. Driy, St. Louis, Mo. App. filed June 14, 1920. For starting induction-repulsion motors.

1,373,340. TROLLEY GUARD; Frank J. Lowry New Orleans, La. App. filed Nov. 30, 1920. To maintain wheel in connection with wire.

1,373,383. DEVICE FOR TESTING ARMATURES; Stephen E. Couch, Springfield, Mass. App. filed Nov. 25, 1919. Used with ignition system of vehicles.

1,373,388. ILLUMINATED DARNING EGG; John B. Warren, New York, N. Y. App. filed Feb. 12, 1920.

(Issued April 5, 1921)

1,373,394. ELECTROLYTIC CELL; Edward A. Allen and Herbert I. Allen, Portland, Me. App. filed Dec. 9, 1919. For electrolysis of brine.

1,373,411. CONROLLING DEVICE; Warren F. Clark, Cleveland, Ohio. App. filed June 7, 1919. To maintain hot plate at predetermined temperature.

1,373,442. RANGE INDICATOR; Elemer Meitner, Brooklyn, N. Y. App. filed Nov. 15, 1915. For visually indicating range.

1,373,447. TELEPHONE-EXCHANGE SYSTEM; Lipa Polinkowsky, Antwerp, Belgium. App. filed Feb. 12, 1920. Selectively operable switching devices.

1,373,471. PROCESS OF SINTERING PHOSPHATIC MATERIALS; Frank S. Washburn, Rye, N. Y. App. filed July 23, 1920. Mixtures of phosphate rock and silica.

1,373,488. PLATING; Charles H. Chandler, Newport, R. I. App. filed June 26, 1919. Depositing more than one metal at same time.

1,373,504. ELECTRICAL MEASURING APPARATUS; Harry W. Hitchcock, New York, N. Y. App. filed Sept. 11, 1918. Variable air condensers.

1,373,517. ELECTRIC CLOCK; Paul Mansel, Charlottenburg, near Berlin, Germany. App. filed April 4, 1918. Secondary clock.

1,373,520. VOLTAGE REGULATOR FOR ELECTRIC DYNAMOS; Friedrich Munz, Stuttgart, Germany. App. filed May 4, 1920. For charging batteries.

1,373,533. PROCESS AND APPARATUS FOR SEVERING SHEET GLASS; Harry G. Slingluff, Mount Vernon, Ohio. App. filed April 12, 1920. Electrically heated.

1,373,557. ELECTROLYTIC PROCESS; William E. Greenawalt, Denver, Col. App. filed March 22, 1920. Deposition of metals from impure solutions.

1,373,558. APPARATUS FOR STARTING MOTORS, MORE PARTICULARLY HEAT MOTORS; Heinrich Guttinger, Baden, Switzerland. App. filed April 9, 1917. For motor cars.

1,373,576. ELECTRIC INSULATOR; Percy H. Thomas, Upper Montclair, N. J. App. filed May 16, 1913. High-tension.

1,373,583. CIGAR-LIGHTING DEVICE; Frank A. Adams, Rochester, N. Y. App. filed Aug. 20, 1919.

1,373,607. SUBSTATION TELEPHONE SET; John Erickson, Chicago, Ill. App. filed Nov. 10, 1916. Automatic party line.

1,373,611. PORTABLE ELECTRIC LIGHT; David L. Graff, New York, N. Y. App. filed April 25, 1918. Flashlamp.

1,373,612. UNDERGROUND LOOP ANTENNA; Earl C. Hanson, Washington, D. C. App. filed March 19, 1919. For receiving radio signals.

1,373,621. SAFETY CHARGING DEVICE FOR BATTERIES; James F. Lincoln, Cleveland, Ohio. App. filed March 21, 1917. Prevents current reversal.

1,373,624. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed May 10. 1916. Improvements in switches.

1,373,639. PROCESS FOR THE ELECTRIC FIXATION OF GASES; George T. Southgate, New York, N. Y. App. filed April 11, 1918. By electric arc.

1,373,689. RESISTANCE DEVICE; Alfred E. Waller, Mount Vernon, N. Y. App. filed March 3, 1919. Strong and light elements.

1,373,693. ANODE; Arthur H. Wicks, Woodstock, Ill. App. filed Feb. 19, 1920. For use in plating tanks.

1,373,710. GENERATOR OF HIGH-FREQUENCY OSCILLATIONS FOR WIRELESS TELEGRAPHY; Victor J. F. Bouchardon, Lyon, France. App. filed Oct. 24, 1919. Combined continuous and damped oscillations.

1,373,733. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING SAME; Harry C. Hubbell, Irvington, N. J. App. filed July 9, 1915. Negative plate for alkaline battery.

1,373,734. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING SAME; Harry C. Hubbell, Irvington, N. J. App. filed July 9, 1915. For alkaline storage battery.

1,373,751. CONDUCTOR CLAMP AND SUPPORT; Samuel S. Matthes, Mansfield, Ohio. App. filed Oct. 6, 1920. Trolley-wire clamp.

1,373,795. ADJUSTABLE MOTOR MOUNT; Arthur A. Byerlein, Toledo, Ohio. App. filed Sept. 20, 1920. Stamping machine.

1,373,801. BATTERY; Edward M. Deems, Forest Hills, N. Y. App. filed Oct. 31, 1919. Primary, one-fluid type.

1,373,802. BATTERY; Edward M. Deems, Forest Hills, N. Y. App. filed Aug. 24, 1920. Primary, one-fluid type.

1,373,806. REGULATOR FOR ELECTRIC LIGHTING SYSTEMS ON MOTOR VEHICLES; John W. FitzGerald, Detroit, Mich. App. filed March 23, 1918. For Ford car.

1,373,809. VAPOR ELECTRIC HEATER; William S. Hadaway, Jr., New Rochelle, N. Y. App. filed July 11, 1917. Vapor passage of varying cross-section.

1,373,818. ELECTROTHERAPEUTIC APPARATUS; Charles L. Ireland, Fort McPherson, Ga. App. filed May 24, 1920. For producing sinusoidal currents.

1,373,820. MINER'S ELECTRIC SAFETY LAMP; John W. Jones, Cannock, England. App. filed May 10, 1920. Can be carried in pocket.

1,373,825. RESISTANCE BOX; Francis W. Magin, Milwaukee, Wis. App. filed June 9, 1920. For motor starting.

1,373,838. PLUG SOCKET; Giorgio Scoppola, Rome, Italy. App. filed Dec. 11, 1920. Applied to line to tap off current.

1,373,842. MINER'S ELECTRIC SAFETY LAMP; Theodore Stretton, Cardiff, Wales. App. filed May 10, 1920.

1,373,846. CONTROLLER FOR ELECTRIC MOTORS; Hermon L. Van Valkenburg, Milwaukee, Wis. App. filed Nov. 21, 1918. For starting and regulating speed.

1,373,873. SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed May 29, 1920.

1,373,895. ELECTRIC HEATER UNIT; Leslie V. Leonard, Richmond, Victoria, Australia. App. filed July 1, 1919. Radiators, stoves, toasters, etc.

1,373,901. DYNAMO-ELECTRIC APPARATUS; Charles Marcus, New York, N. Y. App. filed June 27, 1918. Generator for motor vehicles.

1,373,910. SYSTEM OF DISTRIBUTION; Wilbur A. Pressey, Boston, Mass. App. filed April 23, 1920. Very high voltage transformed to low voltage.

1,373,922. MEANS FOR PREVENTING VOLTAGE FLUCTUATIONS IN DISTRIBUTING CIRCUITS; Louis W. Thompson, Schenectady, N. Y. App. filed May 18, 1918. To prevent objectionable variations in voltage.

1,373,923. ELECTRICAL SYSTEM FOR POWER TRANSMISSION; Magnus Unger, Pittsfield, Mass. App. filed June 14, 1920. To maintain voltage constant.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WAKEFIELD, MASS.—At a special town meeting to be held on April 25 the proposal to appropriate $10,000 for the installation of about 200 additional lamps in Wakefield will be submitted to the voters.

Middle Atlantic States

BROOKLYN, N. Y.—J. L. Hopkins, 477 Keap Street, it is reported, is receiving new bids for the construction of a one-story power house, 34 ft. x 45 ft.

GENEVA, N. Y.—The Geneva Preserving Company, 55 North Street, contemplates the erection of a three-story cold-storage plant, 190 ft. x 200 ft., to cost about $75,000. Electric motors, refrigerating machinery and other mechanical equipment will be installed.

POPLAR RIDGE, N. Y. — The Poplar Ridge Cayuga County Lighting Company has applied to the Public Service Commission, Second District, for permission to erect a lighting plant for service in the town of Venice.

SILVER CREEK, N. Y. — The Silver Creek Electric Company has applied to the Public Service Commission for permission to furnish electricity in Forestville.

TROY, N. Y.—The Ford Motor Company, Detroit, Mich., has awarded a contract for the foundation work for its proposed electric generating plant at Green Island, near Troy. The cost of the plant is estimated at about $2,000,000.

CAMDEN, PA.—The power house and laundry at the Cooper Hospital, it is reported, has been damaged by fire, causing a loss of about $75,000.

MOSCOW, PA. — The Moscow-Elmhurst Electric Company has been organized recently to supply electricity to Moscow, Elmhurst, Roaring Fork, Madison and Covington townships. Energy will be furnished by the Scranton Electric Company.

NEWTOWN SQUARE, PA.—Plans have been prepared for the construction of a power house at the Dunwoody Home for Convalescents.

PHILADELPHIA, PA. — Arrangements are being made by the Philadelphia Electric Company to issue $5,000,000 in stock, the proceeds to be used for improvements, extensions, etc.

PITTSBURGH, PA. — Plans have been prepared for a new one-story power house, 40 ft. x 85 ft., to cost about $45,000, for the Oliver Iron & Steel Company. The W. G. Wilkens Company, Westinghouse Building, is architect.

PITTSBURGH, PA.—Considerable electrical equipment will be installed in the plant of the Crane Company, manufacturer of valves, steam specialties, etc., to be located on Twenty-fourth Street. The cost is estimated at $1,000,000, including equipment. The Hunting-Davis Company, Century Building, is architect.

READING, PA.—Electrical and mechanical equipment will be installed in the proposed municipal filtration plant to be erected at a cost of about $800,000.

SHIPPENSBURG, PA.—A company is being formed by George S. McLean and Lee M. Hale for the purpose of erecting and operating an ice-manufacturing and cold-storage plant. Plans provide for the installation of considerable electrically operated machinery.

BEL AIR, MD.—The Baltimore & Bel Air Electric Company has been granted permission by the Public Service Commission to issue $25,000 in stock for line extensions and improvements.

MILFORD, DEL.—The Milford Electric Company contemplates the installation of new electric generating machinery at its plant.

CHARLESTON, W. VA. — The Cameva Coal Company, Masonic Temple, recently organized, contemplates the installation of electrical equipment at its properties. W. I. Campbell is president.

HUNTINGTON, W. VA. — Considerable electrical equipment and machinery will be installed in the proposed local plant and rolling mill of the International Nickel Company, 43 Exchange Place, New York City. The cost of the plant is estimated at about $2,000,000. Frank I. Ellis, Farmers' Bank Building, Pittsburgh, Pa., is consulting engineer.

WHEELING, W. VA. — The Whitaker-Glessner Company has applied for permit for the construction of a power plant and boiler house at its Manchester plant, north of Wheeling, to cost about $50,000.

RICHMOND, VA.—The question of placing wires on Hull Street in underground conduits is under consideration.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until April 29, Brooklyn, Schedule 7,905—ignition cable; Schedule 7,902—lighting and power wire; Philadelphia, Schedule 7,861—electric hoists. Until May 10, Eastern and Western yards, Schedule 7,904 — electric cable and wire; Schedule 7,927—battery-charging panels; Schedule 7,903—electric wire. Applications for proposal blanks should designate the schedule desired by number.

AURORA, ILL. — The Western United Gas & Electric Company plans to issue $3,000,000 in stock, the proceeds to be used to meet the increasing demands for service.

LENA, ILL.—The Lena Electric Light & Power Company has taken over the lighting plant in Martintown, Wis., which also supplies electricity in Winslow. A transmission line will be erected from Lena to Martintown. Plans are also under way to furnish Monroe with electricity.

ARENA, WIS.—The installation of an electric street-lighting system in Arena is under consideration.

KAUKAUNA, WIS. — Improvements to the municipal light and water systems to cost about $30,000 are under consideration.

MARTINTOWN, WIS.—The local electric light plant has been acquired by the Lena (Ill.) Electric Light & Power Company.

GLENWOOD, MO. — The Raven Coal Company plans to erect a transmission line from Glenwood to Lancaster and Downing, a distance of 6 miles, to furnish electricity in those towns.

INDEPENDENCE, MO. — The proposal to issue $35,000 in bonds for the installation of machinery in the municipal electric light plant will be submitted to the voters on June 1.

NATURAL GAS BURNING STEAM POWER PLANT OF SAN JOAQUIN LIGHT & POWER COMPANY

Gas for this 12,500-kva. plant at Buttonwillow, in Kern County, Cal., will be supplied from the famous Elk Hills gasser, 9 miles away, at a pressure of 450 lb.

North Central States

CINCINNATI, OHIO.—The City Council has granted the Union Light, Heat & Power Company a ten-year franchise to furnish electric lighting service in Bellevue, Ky. Provision is made for the installation of new lamps in place of the arc lamps now in use.

COLUMBUS, OHIO. — Bids will be received at the office of the commissioner of purchases and supplies until April 29 for transformers. Specifications may be obtained at room 204, City Hall.

DAYTON, OHIO.—The installation of a cluster lighting system on Ludlow, Jefferson, Main, Second, Third, Fourth and Fifth Streets to cost about $18,000, is contemplated.

AUXIER, KY.—The United Block Coal Company has plans under way for the construction of a new power plant at its properties. J. C. Snyder is president.

BLUFFTON, IND.—The substation and interlocker plant on the Bluffton-Fort Wayne interurban line, north of Bluffton, was recently damaged by fire, causing a loss of about $20,000.

Southern States

MIDWAY, N. C.—The Midway Lighting & Improvement Company, recently organized with a capital stock of $50,000, plans to operate a local electric system. C. C. Stonestreet is interested in the company.

COLUMBIA, S. C.—The Columbia River & Navigation Company, care of J. Fraser Lyon, Columbia, has applied to the Federal Power Commission for preliminary permit to construct a navigable canal, 24 miles long, from Ferguson on the Santee River to Moncks Corner on the Cooper River, and to develop power near the southern end of the canal for public utility purposes.

LANDRUM, S. C.—The Town Council is considering the installation of a municipal electric power plant and system.

LAKE WORTH, FLA.—The Council is considering an issue of $75,000 in bonds for extensions and improvements to the light and water plants.

MIAMI, FLA.—The Miami Beach Electric Company will submit a proposal to the County Commissioners to light the highway across Biscayne Bay from Miami to Miami Beach.

PABLO BEACH, FLA.—Negotiations are under way between John S. Bond of the Jacksonville City Commission and the City Council of Pablo Beach to purchase electricity for the beach city. A trunk power line, 24 miles long, would be required to convey the power.

ST. PETERSBURG, FLA.—Extensions to the municipal water-works are contemplated. Present plans provide for the construction of a power plant on Mirror Lake, new pumping plant with new machinery and electrically driven pump, two additional wells and water mains. Bonds to the amount of $118,000 are available for this work.

ST. ROSE, LA.—The Petroleum Export & Import Company contemplates the construction of a new power plant and electrically operated pumping plant at its local works.

KAW, OKLA. — The City Council has been petitioned to hold an election to submit to the voters a proposal to issue bonds for improvements to the electric light plant.

LAMONT, OKLA. — Contract has been awarded to the Oklahoma Gas & Electric Company to furnish electricity in Lamont.

AUSTIN, TEX.—The Texas Interurban Railway Company, recently incorporated with a capital stock of $2,500,000, proposes to construct and operate a system of interurban electric railways from Dallas to a number of other cities in Texas. The construction of the line from Dallas to Terrell, a distance of 30 miles, is already under way. J. F. Strickland is among the incorporators.

DALLAS, TEX.—The question of issuing $16,000 in bonds for extensions and improvements to the street and park lighting system in Highland Park, a suburb of Dallas, is under consideration.

FREDERICKSBURG, TEX.—The Fredericksburg Light & Power Company plans to rebuild its local electric power plant, recently damaged by fire. H. A. Ries, vice-president and general manager of the Fredericksburg & Northern Railway Company, is in charge.

WHITNEY, TEX.—Steps will be taken at once to rebuild a local electric plant, owned by C. Gollihar, recently destroyed by fire.

Pacific and Mountain States

LODI, CAL. — The installation of conduits and wiring for electroliers on newly paved streets is under consideration. H. Clarke is clerk.

SACRAMENTO, CAL.—The State Water Commission has granted the following permits to appropriate water for power purposes: The Snow Mountain Water & Power Company, to divert 215,000 acre-ft. of water from the South Eel River, a tributary of the Eel River, in Lake and Mendocino Counties; Frank B. Pattee, Samuel Bernhard and J. T. Ross, 130 cu.ft. per second from the north fork of the Stanislaus River in Calaveras and Tuolumne Counties by means of a dam, canal and pipe line to develop 9,600 hp., the cost being estimated at $2,000,000; H. L. Shannon, San Francisco, 150 cu.ft. per second from Deer Creek by means of a dam, 100 ft. long and ditch and flume, 10 miles long, cost estimated at $500,000.

SAN FRANCISCO, CAL. — Application has been made to the Federal Power Commission by the Rich Point Mining Company, 57 Post Street, for preliminary permit to erect a diversion dam in Bear Creek and conduit to power house on the middle fork of the Feather River in Plumas County.

BUTTE, MONT.—The Boston & Montana Development Company has applied to the Federal Power Commission for permission to erect a 32-mile transmission line to its plant at Elkhorn to furnish 2,000 hp. The cost of the work is estimated at $100,000.

THERMOPOLIS, WYO.—The local lighting plant, it is reported, was damaged by fire recently, causing a loss of about $50,000.

CARSON, NEV.—A bill known as Senate Bill No. 61, which authorizes the Board of Commissioners of Mineral County to issue $150,000 in bonds for the purpose of purchasing and extending the Lundy-Hawthorne transmission lines of the Nevada-California Power Company has been passed by the State Legislature. The project includes the erection of transmission lines from the Lundy generating station of the Nevada-California Power Company, situated in the county of Mono, Cal., to the town of Hawthorne, Nev., thence to Simon, via Luning and Mina, Nev., and branches.